Mark Scheme (Results)

June 2024

Pearson Edexcel International Advanced Subsidiary Level In Physics (WPH13) Paper 01 Practical Skills in Physics I

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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.

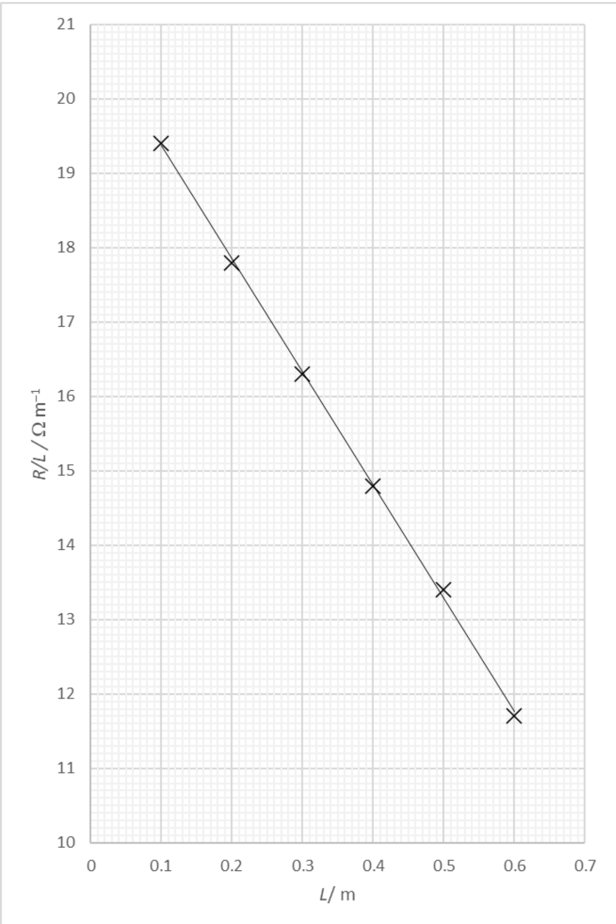
Question Number	Answer	Mark
1(a)(i)	The stand may topple over **(1)** Clamp (the base of the stand) to the bench **Or** Place a heavy mass on the (base of the) stand **Or** Turn the base (of the stand) round (by 180°) **(1)** The (rubber) band may hit the student in the eye/face **(1)** **Or** The (rubber) band may damage the eye Wear eye protection **(1)**	**4**
1(a)(ii)	Add masses (gradually) until the (rubber) band breaks **(1)** Calculate the force using $F = mg$ Accept W **(1)**	**2**
1(b)	(Repeating the measurement) reduces (the effect of) <u>random error</u> **(1)** (Caused by) variations in the temperature of the rubber bands **(1)** MP1 do not accept systematic error	**2**
	Total for question 1	**8**

Question Number	Answer	Mark
2(a)(i)	Height (of the initial position) of the ball **Or** The initial velocity of the ball Accept ball is stationary when released **(1)**	**1**
2(a)(ii)	Height affects the gravitational potential energy of the ball **Or** Height affects how long the ball accelerates for **Or** Initial velocity affects the initial kinetic energy of the ball **(1)** (So) The (impact) velocity of the ball may vary **(1)** **Or** The (impact) kinetic energy may vary MP1 must be linked to the control variable stated	**2**
2(b)	Any **THREE** from The values (of x and θ) are not recorded to consistent decimal places **(1)** There is no evidence of repeats **(1)** There are not enough sets of data (to draw a reliable graph) **(1)** The reading of x at 20.5° does not follow the trend **(1)**	**3**
2(c)	**EITHER** Use a camera to record the motion **(1)** Which can be viewed in slow motion (to find the exact point where the ball landed) **(1)** **OR** Place a tray of sand on the bench for the ball to land in **(1)** So that the ball remains stationary when it lands **Or** so the ball leaves an indentation where it lands **(1)**	**2**
	Total for question 2	**8**

Question Number	Answer	Mark
3(a)	Clamp the metre rule in position **Or** Ensure the metre rule is vertical using a set square [allow spirit level] **Or** Place metre rule close to the tube **(1)** Check the zero of the metre rule is level with the bottom of the transducer **Or** Check the zero of the metre rule is level with the surface of the water **Or** Measure to the surface of the water and to the bottom of the transducer and subtract the values **(1)** Accept any valid method to determine *s* View (the metre rule) perpendicularly **Or** Use a set square to take the measurement from the metre rule **(1)**	**3**
3(b)	Calculates time t = number of divisions × time per division **(1)** Use of $v = \frac{s}{t}$ Do not accept use of $v = f\lambda$ **(1)** Uses $2 \times s$ **Or** Uses $\frac{1}{2} \times t$ **(1)** $v = 331$ (m s^{-1}) Bald answer scores 0 **(1)** <u>Example of calculation</u> t = 6 divisions × 0.5 ms per division = 3 ms $v = \frac{s}{t} = \frac{2 \times 0.497\ \text{m}}{3 \times 10^{-3}\ \text{s}} = 331.3\ \text{m s}^{-1}$	**4**
3(c)(i)	Calculation of mean **(1)** Mean $v = 341\ \text{m s}^{-1}$ 3 sig fig only **(1)** <u>Example of calculation</u> Mean value of $v = \frac{(335 + 347 + 339 + 342)\ \text{m s}^{-1}}{4} = \frac{1363\ \text{m s}^{-1}}{4} = 340.8 = 341\ \text{m s}^{-1}$	**2**
3(c)(ii)	Calculates half range for uncertainty Accept furthest from the mean **(1)** Correct value of percentage uncertainty using calculated mean (e.c.f. 3(c)(i)) **(1)** <u>Example of calculation</u> Uncertainty = half range $= \frac{(347 - 335)\ \text{m s}^{-1}}{2} = 6\ \text{m s}^{-1}$ Percentage uncertainty $= \frac{6\ \text{m s}^{-1}}{341\ \text{m s}^{-1}} \times 100 = 1.8\%$	**2**

3(d)	**EITHER** Upper limit = 1502 ($m\ s^{-1}$) **(1)** Conclusion consistent with comparing calculated limit and given value **(1)** <u>Example of calculation</u> Upper limit = $1444\ m\ s^{-1} \times 1.04 = 1502\ (m\ s^{-1})$ The upper limit is above 1481 $m\ s^{-1}$ so the student's value is consistent **OR** Percentage difference = 2.5 % **(1)** Conclusion consistent with comparing calculated percentage difference with 4% **(1)**	**2**
	Total for question 3	**13**

Question Number	Answer	Mark
4(a)(i)	Calculates percentage uncertainty = half resolution / measurement × 100% **(1)** Percentage uncertainty = 2 % Accept 1.9 % **(1)** <u>Example of calculation</u> Percentage uncertainty = $\frac{0.005\ \text{mm}}{0.27\ \text{mm}} \times 100 = 1.85\ \% = 2\ \%$	**2**
4(a)(ii)	**EITHER** Check (and correct) for zero error **(1)** To eliminate <u>systematic error</u> **(1)** MP2 dependent on MP1 **OR** Use the ratchet (to prevent overtightening) **(1)** To reduce (the effect of) <u>random error</u> **(1)** MP2 dependent on MP1	**2**
4(b)	The fixed resistor limits the (maximum) current in the circuit **(1)** So the wire/circuit does not overheat **Or** so there is not a short circuit **Or** so the ammeter/battery is not damaged **(1)**	**2**

4(c)(i)	($\frac{R}{L} = -kL + \frac{\rho}{A}$) compares to $y = mx + c$ where $\frac{\rho}{A}$ is the y-intercept So ρ can be calculated from the y-intercept multiplied by A.	**(1)** **(1)**	**2**
4(c)(ii)	Correct values of $\frac{R}{L}$ units not required in table heading Values consistent to 3 sig figs	**(1)** **(1)**	**2**
4(c)(iii)	Axis labels: y as $\frac{R}{L}$ / Ω m^{-1} and x as L / m Sensible scales Accurate plotting Line of best fit 	**(1)** **(1)** **(2)** **(1)**	**5**

L / m	I / A	V / V	$\frac{R}{L}$ / Ω m^{-1}
0.100	0.720	1.40	19.4
0.200	0.390	1.39	17.8
0.300	0.290	1.42	16.3
0.400	0.250	1.48	14.8
0.500	0.220	1.47	13.4
0.600	0.210	1.47	11.7

4(c)(iv)	Calculates gradient using large triangle **(1)** k = in range (–)14.4 to (–)15.6 **(1)** k given to 2 or 3 s.f., positive, units $\Omega\ m^{-2}$ **(1)** <u>Example of calculation</u> $k = -\text{gradient} = -\frac{19.4 - 13.3}{0.1 - 0.5} = 15.3$		**3**
4(c)(v)	y-intercept determined from graph **Or** Calculation of y-intercept using gradient and data point from best fit line **(1)** Uses $A = \frac{\pi d^2}{4}$ **(1)** Correct value of ρ given to 2 or 3 s.f. with units Ω m (e.c.f. 4(c)(iv)) **(1)** <u>Example of calculation</u> y-intercept = $20.9\ \Omega\ m^{-1}$ $A = \frac{\pi d^2}{4} = \frac{\pi (0.27 \times 10^{-3}\ m)^2}{4} = 5.73 \times 10^{-8}\ m^2$ $\rho = 20.9\ \Omega\ m^{-1} \times 5.73 \times 10^{-8}\ m^2 = 1.2 \times 10^{-6}\ \Omega\ m$		**3**
	Total for question 4		**21**

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