Pearson Edexcel

Mark Scheme (Results)

January 2023

Pearson Edexcel International Advanced Subsidiary Level in Physics (WPH13)
Paper 01 Unit 3: Practical Skills in Physics I

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January 2023
Question Paper Log Number P71947A
Publications Code WPH13_01_MS_2301

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.

Mark scheme notes

Underlying principle

The mark scheme will clearly indicate the concept that is being rewarded, backed up by examples. It is not a set of model answers.

1. **Mark scheme format**
   1.1 You will not see 'wtte' (words to that effect). Alternative correct wording should be credited in every answer unless the MS has specified specific words that must be present. Such words will be indicated by underlining e.g. '<u>resonance</u>'
   1.2 Bold lower case will be used for emphasis e.g. '**and'** when two pieces of information are needed for 1 mark.
   1.3 Round brackets ( ) indicate words that are not essential e.g. "(hence) distance is increased".
   1.4 Square brackets [ ] indicate advice to examiners or examples e.g. [Do not accept gravity] [ecf].

2. **Unit error penalties**
   2.1 A separate mark is not usually given for a unit but a missing or incorrect unit will normally mean that the final calculation mark will not be awarded.
   2.2 This does not apply in 'show that' questions or in any other question where the units to be used have been given, for example in a spreadsheet.
   2.3 The mark will not be awarded for the same missing or incorrect unit only once within one clip in epen.
   2.4 Occasionally, it may be decided not to insist on a unit e.g the candidate may be calculating the gradient of a graph, resulting in a unit that is not one that should be known and is complex.
   2.5 The mark scheme will indicate if no unit error is to be applied by means of [no ue].

3. **Significant figures**
   3.1 Use of too many significant figures in the theory questions will not be prevent a mark being awarded if the answer given rounds to the answer in the MS.
   3.2 Too few significant figures will mean that the final mark cannot be awarded in 'show that' questions where one more significant figure than the value in the question is needed for the candidate to demonstrate the validity of the given answer.
   3.3 The use of one significant figure might be inappropriate in the context of the question e.g. reading a value off a graph. If this is the case, there will be a clear indication in the MS.
   3.4 The use of g = 10 m s^{-2} or 10 N kg^{-1} instead of 9.81 m s^{-2} or 9.81 N kg^{-1} will mean that one mark will not be awarded. (but not more than once per clip). Accept 9.8 m s^{-2} or 9.8 N kg^{-1}
   3.5 In questions assessing practical skills, a specific number of significant figures will be required e.g. determining a constant from the gradient of a graph or in uncertainty calculations. The MS will clearly identify the number of significant figures required.

4. Calculations

4.1 Bald (i.e. no working shown) correct answers score full marks unless in a 'show that' question.

4.2 If a 'show that' question is worth 2 marks. then both marks will be available for a reverse working; if it is worth 3 marks then only 2 will be available.

4.3 **use** of the formula means that the candidate demonstrates substitution of physically correct values, although there may be conversion errors e.g. power of 10 error.

4.4 **recall** of the correct formula will be awarded when the formula is seen or implied by substitution.

4.5 The mark scheme will show a correctly worked answer for illustration only.

5. Graphs

5.1 A mark given for axes requires both axes to be labelled with quantities and units, and drawn the correct way round.

5.2 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.

5.3 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.

5.4 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)	• 0.001 MΩ **(1)**	**1**
1(a)(ii)	• Use of percentage uncertainty = half resolution / measurement × 100% **(1)** • Percentage uncertainty = 0.173 % **(1)** Accept use of percentage uncertainty = resolution / measurement × 100%, giving 0.346% for 1 mark only. Allow e.c.f. from 1(a)(i). <u>Example of calculation</u> Percentage uncertainty = 0.0005 MΩ / 0.289 MΩ × 100 % = 0.173 %	**2**
1(b)(i)	Mark 1(b)(i) and 1(b)(ii) holistically. • Use ruler to measure length between the electrodes **and** measure width of shading **Or** measure length between electrodes **and** width of shading using the squared paper **(1)** • Measure *R* at different values of length **(1)** • Plot graph of *R* vs length **(1)** • Calculate thickness using gradient = resistivity / (width × thickness) **(1)**	**4**
1(b)(ii)	Any ONE from • Contact resistance between electrode and pencil shading **(1)** • Zero error on ohmmeter (Accept zero error for a suitable measuring device named in (b)(i)) **(1)** • Electrodes not parallel **(1)**	**1**
	Total for question 1	**8**

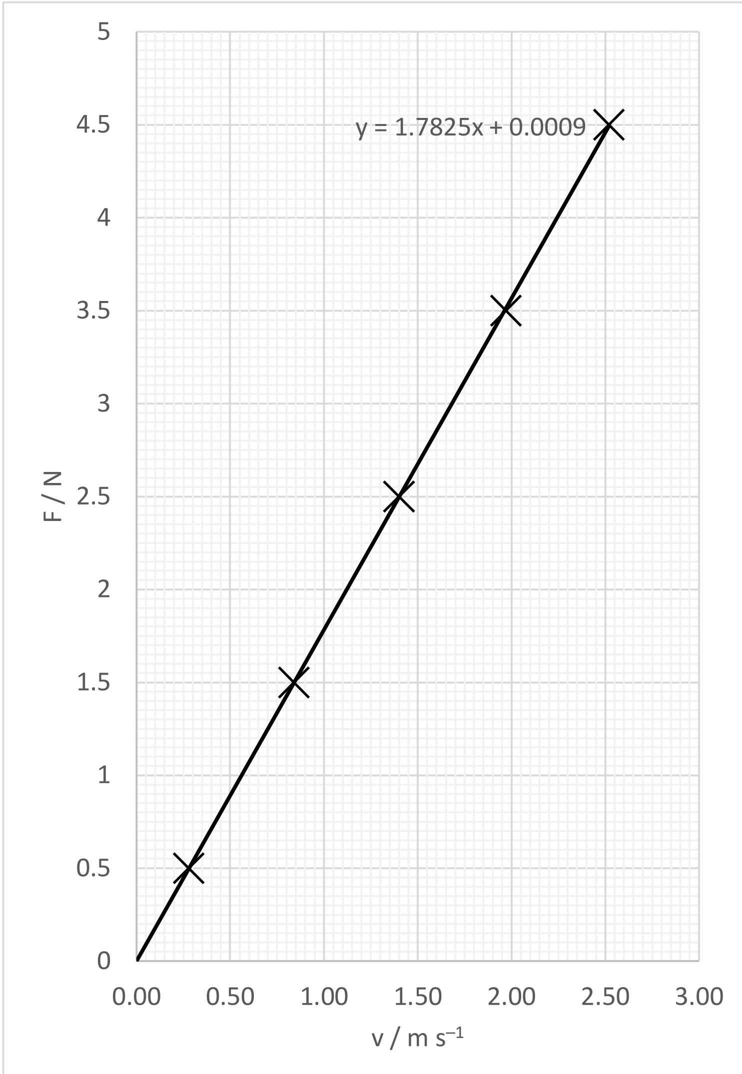
Question Number	Answer		Mark
2(a)(i)	• To ensure the sound waves are coherent **Or** to ensure the two waves have a constant phase relationship **Or** to ensure the two sound waves have the same frequency **and** wavelength **Or** to ensure the sound waves are produced in phase	**(1)**	**1**
2(a)(ii)	• Loud sound could damage hearing/ears (accept named part of the ear e.g., ear drum) • Wear ear defenders/plugs **Or** limit the volume of sound **Or** limit the duration/time of the exposure **Or** do not stand too close to the loudspeakers	**(1)** **(1)**	**2**
2(b)(i)	• Subtraction of distance between two maxima • Calculation of average distance between maxima using a minimum of 3 gaps • $w = 0.62$ m <u>Example of calculation</u> Total distance = 3.33 – 0.22 = 3.11 m Number gaps = 5 $w = 3.11 / 5 = 0.62$ m	**(1)** **(1)** **(1)**	**3**
2(b)(ii)	• Use of $w = \lambda D / s$ • Correct value of λ to 2 s.f. with correct unit Allow e.c.f. from 2(b)(i) <u>Example of calculation</u> $\lambda = sw / D = 1.10 \text{ m} \times 0.62 \text{ m} / 4.0 \text{ m} = 0.1705 = 0.17 \text{ m}$	**(1)** **(1)**	**2**
2(b)(iii)	• The connections to one of the speakers were reversed **Or** waves emitted from the two speakers are in antiphase • So destructive interference takes place	 **(1)** **(1)**	**2**
2(c)(i)	• As $v = f\lambda$, so the frequency would need to be determined • States suitable apparatus to measure the <u>frequency</u> (e.g. frequency meter, oscilloscope, suitable app on a mobile phone, etc.)	**(1)** **(1)**	**2**
2(c)(ii)	• As $\lambda = v / f$, λ will increase (for a constant f) **Or** if v increases (for a constant f,) λ will increase • (As $w = \lambda D / s$), w will increase as D and s remain constant **OR** • $w = v D / f s$ • Hence as v increases, w will increase as f, D and s remain constant	 **(1)** **(1)** **(1)** **(1)**	**2**
	Total for question 2		**14**

Question Number	Answer		Mark
3(a)(i)	• The uncertainty would be 0.05 cm **Or** resolution would be 0.1 cm • The percentage uncertainty would be about 1% (which is small) Allow MP1 for correct uncertainty as seen in a calculation. Accept uncertainty as full resolution (0.1 cm) giving percentage uncertainty of 2% for MP2	 **(1)** **(1)**	**2**
3(a)(ii)	**Max TWO from** • Attach a marker to the spring **Or** use a set square between ruler and spring **Or** ensure ruler is close to spring • View the scale at right angles • Ensure the ruler is at zero at the support • Ensure the ruler is vertical using a set square	 **(1)** **(1)** **(1)** **(1)**	**2**
3(b)(i)	• Number of decimal places varies (for both W and l)	**(1)**	**1**
3(b)(ii)	• The student should check the value at $W = 0.39$ N, $l = 12$ cm • As it is furthest from the line of best fit	**(1)** **(1)**	**2**
3(b)(iii)	• W in the range of 0.22 to 0.24 (N)	**(1)**	**1**
3(c)(i)	• Use of density of modelling clay = density water × $W_1 / (W_1 - W_2)$ • Density of modelling clay = 1700 kg m^{-3} <u>Example of calculation</u> Density of modelling clay = 1000 kg m^{-3} × 0.65 N / (0.65 N − 0.27 N) Density of modelling clay = 1710 kg m^{-3}	**(1)** **(1)**	**2**
3(c)(ii)	• Calculation of relevant limit of density of modelling clay from (c)(i) • Conclusion consistent with calculated limit/range <u>Example of calculation</u> Limit of density = 1710 × 1.04 = 1778 kg m^{-3} As this is above value 1760 kg m^{3} then it could be polymer clay **OR** • Calculation of percentage difference (from 1760 kg m^{-3}) • Conclusion based on comparison of the percentage difference and 4 % <u>Example of calculation</u> Percentage difference = (1760 kg m^{-3} − 1710 kg m^{-3}) / 1760 kg m^{-3} × 100% = 2.8 % As this is less than 4 % then it could be polymer clay Allow e.c.f. from 3(c)(i)	**(1)** **(1)** **(1)** **(1)**	**2**
	Total for question 3		**12**

Question Number	Answer	Mark
4(a)(i)	• Calculation of mean **(1)** • Mean t = 3.56 (s) to 3 s.f. **(1)** <u>Example of calculation</u> Mean value of time = (3.57 s + 3.61 s + 3.54 s + 3.51 s) / 4 = 3.5575 = 3.56 s	**2**
4(a)(ii)	• Use of half range for uncertainty **Or** uncertainty = max distance from the mean **(1)** • Percentage uncertainty = 1.4% **(1)** Allow e.c.f. from 4(a)(i) <u>Example of calculation</u> Uncertainty = half range = (3.61 s – 3.51 s) / 2 = 0.05 s Percentage uncertainty = 0.05 s / 3.56 s × 100% = 1.4 %	**2**
4(b)	• Place a light gate (at each marker) **(1)** • To (start and) stop an electronic/digital timer **Or** use a datalogger/computer to determine the time **(1)** **OR** • Use video camera **(1)** • Valid method to find time (e.g., count the number of frames) **(1)**	**2**
4(c)(i)	• Rearranges equation to $F = (M / t)\ v$ and compares with $y = mx\ (+ c)$ **(1)** • So, the gradient = M / t **(1)** **OR** • Rearranges equation to $F/ v = M / t$ **(1)** • States that gradient of graph = F/ v **(1)** **OR** • Rearranges equation to $t = M\ v / F$ **(1)** • States that gradient of graph = F/ v **Or** states that 1/gradient of graph = v / F **(1)**	**2**

<table>
<tr>
<td>4(c)(ii)</td>
<td>

- Labels axes with quantities and units **(1)**
- Sensible scales **(1)**
- Plotting **(2)**
- Line of best fit **(1)**



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<tr><th>F / N</th><th>v / m s⁻¹</th></tr>
<tr><td>0.5</td><td>0.28</td></tr>
<tr><td>1.5</td><td>0.84</td></tr>
<tr><td>2.5</td><td>1.40</td></tr>
<tr><td>3.5</td><td>1.97</td></tr>
<tr><td>4.5</td><td>2.52</td></tr>
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<td>5</td>
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<tr>
<td>4(c)(iii)</td>
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- Calculates gradient using large triangle **(1)**
- Use of gradient = M / t **(1)**
- t in the range of 0.068 to 0.072 s **(1)**

<u>Example of calculation</u>

Gradient $= \frac{4.0-1.0}{2.25-0.55} = 1.76$

$t = \frac{0.125\ \mathrm{kg}}{1.76\ \mathrm{N\ m^{-1}s}} = 0.07\ \mathrm{s}$

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<td>3</td>
</tr>
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<td>Total for question 4</td>
<td>16</td>
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