Pearson Edexcel

Mark Scheme (Results)

October 2021

Pearson Edexcel International Advanced Subsidiary Level in Physics (WPH13)
Paper 1
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.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed.

  The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear

  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter

  iii) organise information clearly and coherently, using specialist vocabulary when appropriate.

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.

- Check the first and last points and the two points furthest from the best fit line.
  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)	• Heating (to 100 ˚C) – suitable method described (e.g. water bath, kettle) (1) • Cooling (to 10 ˚C) – suitable method described (e.g. ice bath, freezer) (1)	**2**
1(b)	• Use of uncertainty = half resolution (0.005 V) (1) • Percentage uncertainty = 0.07 (%) (1) Accept use of resolution (0.01 V), giving percentage uncertainty of 0.15% for MP2 only <u>Example calculation</u> Percentage uncertainty = (0.005/6.85) × 100% Percentage uncertainty = 0.073%	**2**
1(c)(i)	• Line of best fit drawn up to *V* axis (1) • Value between 8.2 and 8.6 (V) (1) MP1 – accept a straight line of best fit covering at least the first 5 plots MP2 – if a line of best fit is drawn, the value given must match the y-axis intercept ± 1 mm and be within the range stated	**2**
1(c)(ii)	• Use of 12 V = ∑ p.d. (1) • Use of $V = IR$ (1) • Correct value calculated with unit (1) Note – ecf from 1(c)(i) applies MP1 & 2 can be awarded for correct use of the potential divider ratios rule (e.g., $V_{\text{fixed res}}$ / 12 V = 4700 Ω / (4700 Ω + R_{therm}) <u>Example calculation</u> V_{therm} = 8.4 V V_{fixed} = 3.6 V $V = IR$ 3.6 V = I × 4.7×10^3 Ω I = 3.6 V / 4.7×10^3 Ω = 7.7×10^{-4} A $V = IR$ 8.4 V = 7.7×10^{-4} A × R R = 8.4 V / 7.7×10^{-4} A = 1.1×10^4 Ω	**3**

1(d)	• Calculates $V \times \theta$ for at least two pairs of values from the graph/table **Or** calculates proportional change for at least two pairs of values (1) • Conclusion consistent with values calculated (1) Do not award MP2 if temperatures are not converted to Kelvin <u>Example calculation</u> Pair 1 $V \times \theta$ = 3.5 V × (60 + 273 K) = 1170 V K Pair 2 $V \times \theta$ = 5.7 V × (30 + 273 K) = 1730 V K	**2**
	Total for question 1	**11**

Question Number	Answer		Mark
2(a)	• Path difference between microwaves reflected from metal plate and reflected from glass plate **Or** phase difference between microwaves reflected from metal plate and reflected from glass plate • (Reflected) waves superpose/interfere (at the receiver) • As *d* is varied, path/phase difference changes causing constructive **and** destructive interference	(1) (1) (1)	**3**
2(b)(i)	• Determines the mean distance between maxima • λ = 2 × distance between maxima • λ = 2.8 cm rounded to 2 s.f. <u>Example calculation</u> Mean distance between maxima = (1.2 cm +1.6 cm +1.2 cm +1.5 cm)/4 Mean distance between maxima = 1.38 cm λ = 2 × 1.38 cm λ = 2.8 cm	(1) (1) (1)	**3**
2(b)(ii)	• Use of $c = f\lambda$ • $f = 1.1\times10^{10}$ Hz Note – allow ecf from 2(b)(i) <u>Example calculation</u> $c = f\lambda$ 3.0×10^{8} m s^{-1} = f × 0.028 m $f = 3.0\times10^{8}$ m s^{-1} / 0.028 m $f = 1.1\times10^{10}$ Hz	(1) (1)	**2**
	Total for question 2		**8**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>3(a)</td><td>• Sample of nylon secured at one end (1)
• Slotted masses hung from the opposite end (1)
• Force/mass increased until sample breaks (1)
• F = mg to calculate the force
Or use a force meter to measure the weight of the mass (1)

MP1 & 2 can be awarded from a diagram.</td><td>4</td></tr>
<tr><td>3(b)</td><td>• Comment identifying an appropriate safety issue (1)
• Associated control measure (1)

<u>Examples</u>
• Masses falling on feet
• Ensure feet are not underneath

• Snapped nylon hitting eyes
• Wear safety glasses</td><td>2</td></tr>
<tr><td>3(c)(i)</td><td>• Mean diameter = 0.55 (mm) (1)
• Use of half range
Or value furthest from mean (1)
• Percentage uncertainty = 3.6 (%) (1)

<u>Example of Calculation</u>
Mean = (0.55 mm + 0.57 mm + 0.54 mm + 0.55 mm + 0.53 mm)/5
Mean = 0.55 mm
Range = 0.57 mm – 0.53 mm = 0.04 mm
Percentage uncertainty = (0.02 mm / 0.55 mm) × 100 % = 3.6 %</td><td>3</td></tr>
<tr><td>3(c)(ii)</td><td>• Use of $A = \pi r^2$
Or use of $A = \pi d^2/4$ (1)
• Use of σ = F / A for sample before absorbing water (1)
• Use of σ = F / A for sample after absorbing water (1)
• Calculation of a percentage change (1)
• Comparative statement consistent with calculated values (1)

<u>Example of Calculation</u>

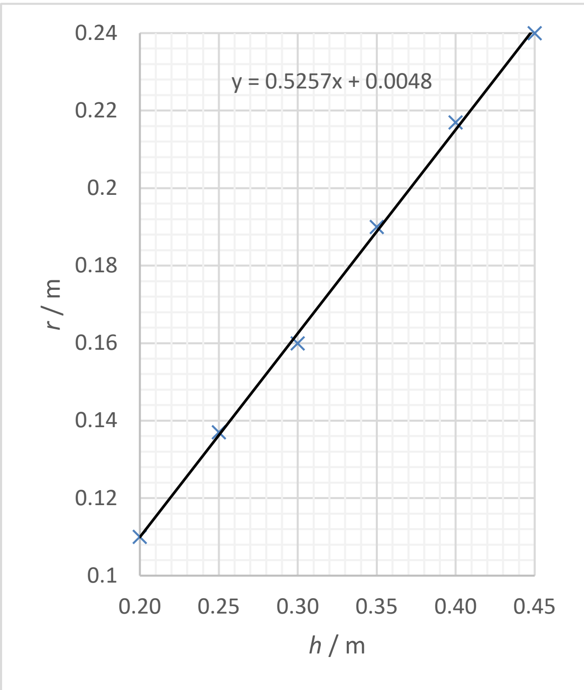
Before
$A = \pi r^2$
$A = \pi \times (2.25\times10^{-4}\ \text{m})^2$
$A = 1.59\times10^{-7}\ \text{m}^2$
σ = F / A
$\sigma = 65.8\ \text{N} / 1.59\times10^{-7}\ \text{m}^2$
$\sigma = 4.1\times10^{8}\ \text{Pa}$

After
$A = \pi r^2$
$A = \pi \times (2.3\times10^{-4}\ \text{m})^2$
$A = 1.66\times10^{-7}\ \text{m}^2$
σ = F / A
$\sigma = 57.8\ \text{N} / 1.66\times10^{-7}\ \text{m}^2$
$\sigma = 3.5\times10^{8}\ \text{Pa}$

Percentage change
% difference = $((4.1\times10^{8} - 3.5\times10^{8}) / 4.1\times10^{8}) \times 100\% = 15\%$</td><td>5</td></tr>
<tr><td></td><td>Total for question 3</td><td>14</td></tr>
</table>

<table>
<tr><th>Question Number</th><th>Answer</th><th></th><th>Mark</th></tr>
<tr><td>4(a)(i)</td><td>Max 2 from
• Inconsistent d.p. in r
• No repeat readings (for r)
• All values (of h and r) should be to the nearest mm
Or all values (of h and r) should be to 3 d.p.</td><td>
(1)
(1)

(1)</td><td>2</td></tr>
<tr><td>4(a)(ii)</td><td>• Labels axes with quantities and units
• Sensible scales
• Plotting
• Line of best fit



<table>
<tr><th>h / m</th><th>r / m</th></tr>
<tr><td>0.20</td><td>0.11</td></tr>
<tr><td>0.25</td><td>0.137</td></tr>
<tr><td>0.30</td><td>0.16</td></tr>
<tr><td>0.35</td><td>0.19</td></tr>
<tr><td>0.40</td><td>0.217</td></tr>
<tr><td>0.45</td><td>0.24</td></tr>
</table></td><td>(1)
(1)
(2)
(1)</td><td>5</td></tr>
<tr><td>4(b)(i)</td><td>• $mgh = ½mv^2$
• Algebra steps shown leading to $u = \sqrt{2gh}$
Do not accept use of $v^2 = u^2 + 2as$</td><td>(1)
(1)</td><td>2</td></tr>
<tr><td>4(b)(ii)</td><td>• See $v = \sqrt{2gr}$
• Shows that $e = \frac{\sqrt{r}}{\sqrt{h}}$
• Gradient = $\frac{\Delta r}{\Delta h}$ therefore gradient = e^2

Accept substitution of $u = \sqrt{2gh}$ and v= $\sqrt{2gr}$ into e = v/u and re-arrangement into y = mx format for MP2 and 3</td><td>(1)
(1)
(1)</td><td>3</td></tr>
<tr><td>4(c)</td><td>• Calculates gradient using large triangle
(allow use of $e^2 = \frac{r}{h}$)
• Gradient / e^2 value between 0.51 and 0.56
Or e value between 0.71 and 0.75
• Correct choice of metal for value of e calculated

<u>Example of Calculation</u>
e^2 = (0.22 – 0.12)/(0.41 – 0.22)</td><td>
(1)

(1)
(1)</td><td>3</td></tr>
</table>

	$e^2 = 0.53$ $e = 0.73$ so stainless steel		
4(d)	• Acceleration along the ramp would be smaller, so *r* would be lower (for a given *h*) **Or** friction would reduce velocity, so *r* would be lower (for a given *h*) **Or** friction would dissipate energy, so *r* would be lower (for a given *h*) • (The gradient and) the value obtained for *e* would be smaller [dependent on MP1]	(1) (1)	**2**
	Total for question 4		**17**