Pearson

Mark Scheme (Results)

Summer 2026

Pearson Edexcel International Advanced Level In Physics
WPH16/01

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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 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.**

For example:

(iii) Horizontal force of hinge on table top

66.3 (N) or 66 (N) and correct indication of direction [no ue] (1) **1**

[Some examples of direction: acting from right (to left) / to the left / West / opposite direction to horizontal. May show direction by arrow. Do not accept a minus sign in front of number as direction.]

This has a clear statement of the principle for awarding the mark, supported by some examples illustrating acceptable boundaries.

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.

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 Incorrect use of case e.g. 'Watt' or 'w' will not be penalised.

2.3 There will be no unit penalty applied in 'show that' questions or in any other question where the units to be used have been given, for example in a spreadsheet.

2.4 The same missing or incorrect unit will not be penalised more than once within one question (one clip in ePen).

2.5 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.

2.6 The mark scheme will indicate if no unit error is to be applied by placing brackets around the unit.

3. Significant figures

3.1 Use of an inappropriate number of significant figures in the theory papers will normally only be penalised in 'show that' questions where use of too few significant figures has resulted in the candidate not demonstrating the validity of the given answer.

3.2 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 be penalised by one mark (but not more than once per clip).
Accept 9.8 m s^{-2} or 9.8 N kg^{-1}

3.3 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 the question is worth 3 marks then only 2 marks 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.

Example of mark scheme for a calculation:

'Show that' calculation of weight

Use of L × W × H	(1)	
Substitution into density equation with a volume and density	(1)	
Correct answer [49.4 (N)] to at least 3 sig fig. [No ue]	(1)	**3**

[If 5040 g rounded to 5000 g or 5 kg, do not give 3rd mark; if conversion to kg is omitted and then answer fudged, do not give 3rd mark]

[Bald answer scores 0, reverse calculation 2/3]

Example of calculation

80 cm × 50 cm × 1.8 cm = 7200 cm3

7200 cm^3 × 0.70 g cm^{-3} = 5040 g

5040 × 10^{-3} kg × 9.81 N/kg= 49.4 N

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 and is not an awkward scale e.g. multiples of 3, 7 etc.

5.4 Points should be plotted to within 1 mm.
Check all the points - If any is more than 1mm out do not award mark.

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

Question Number	Acceptable Answer		Additional Guidance	Mark
1(a)(i)	• 5 cm^3	**(1)**	Ignore ± symbol	**1**
1(a)(ii)	• Uses half resolution • %U = 0.5 % Accept 0.52% or 0.521%	**(1)** **(1)**	Allow e.c.f. for the resolution stated in 1(a)(i) Example of calculation Half resolution = 0.5 × 5 cm^3 = 2.5 cm^3 %U = $\frac{2.5\ cm^3}{480\ cm^3} \times 100 = 0.521$ %	**2**
1(b)	• Determines no. of horizontal divisions for minimum of 2 waves • Uses no. of horizontal divisions × 2.0 ms • Use of $T = \frac{1}{f}$ • f = 230 (Hz)	**(1)** **(1)** **(1)** **(1)**	Example of Calculation $2T$ = 4.4 divisions × 2.0×10^{-3} s = 8.8×10^{-3} s $T = \frac{8.8\times10^{-3}\ s}{2} = 4.4\times10^{-3}$ s $f = \frac{1}{T} = \frac{1}{4.4\times10^{-3}s} = 227$ Hz	**4**
1(c)	An answer that makes reference to four of the following points: • There are not enough data points • The range of data is too small • There may be systematic error in V • So, an accurate best-fit line cannot be drawn • Therefore, the gradient may not be close to the true value	 **(1)** **(1)** **(1)** **(1)** **(1)**	Ignore references to significant figures, repeats readings, inconsistent intervals. Ignore “systematic error” on its own Ignore “increased uncertainty” in the line/gradient	**4**

(Total for Question 1 = 11 marks)

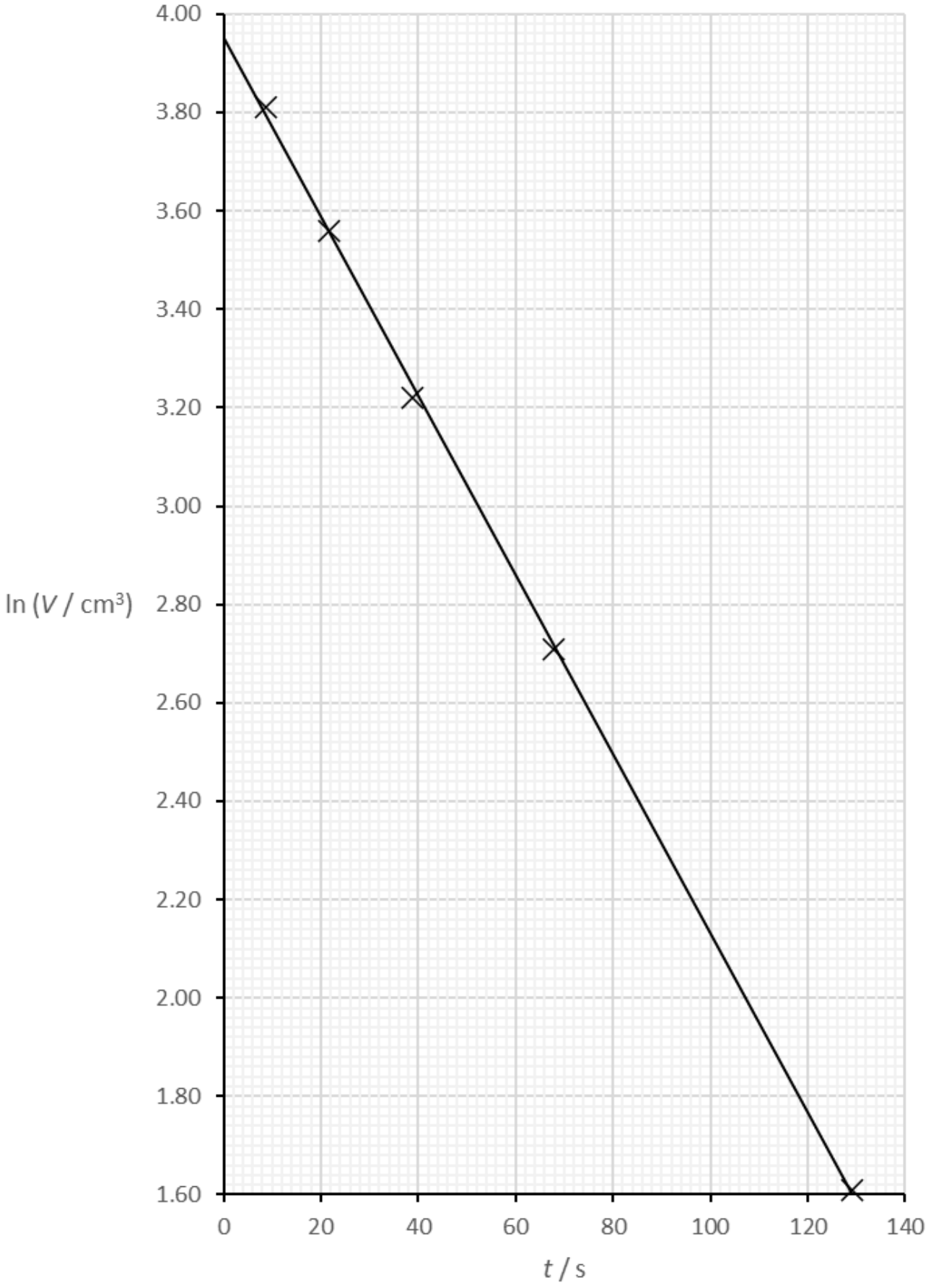
Question Number	Acceptable Answer	Additional Guidance	Mark
2(a)	An answer that makes reference to two of the following points: • Handle the source with tongs **(1)** • Use the source for as short a time as possible **(1)** • Stand away from the source **Or** do not direct the source towards the body **(1)** • Store the source in a lead-lined container **(1)**		**2**
2(b)	A description that makes reference to the following points: • Record a background count (rate) **and** subtract from all readings **(1)** • Measure *d* with a metre rule **(1)** • Ensure the source and G-M tube are aligned **Or** ensure the metre rule is close to the apparatus **Or** use a set square to measure the distance on the metre rule **(1)** • Record the count (rate) over a long period of time **Or** record the count (rate) several times at the same distance and calculate a mean **Or** repeat (for increasing distance) until the count (rate) reaches the background count (rate) **(1)** • Record the count (rate) for at least 5 different values of *d* **(1)** • Plot a graph of *C* against $\frac{1}{d^2}$ and check the graph is a straight line through the origin **Or** plot a graph of log *C* against log *d* and check the gradient equals −2 **(1)**	Accept tape measure Accept a stated time of at least 1 minute.	**6**

(Total for Question 2 = 8 marks)

Question Number	Acceptable Answer	Additional Guidance	Mark
3(a)	An answer that makes reference to the following points: **EITHER** • Removes the delay between opening the tap and starting the stopwatch **Or** it will be difficult to open tap and start stopwatch at the same time **(1)** **OR** • Allows the flow rate to be constant (when the stopwatch is started) **(1)**	Ignore references to "reaction time"	**1**
3(b)(i)	An explanation that makes reference to the following points: **EITHER** • $\ln V = \ln 50 - bt$ **(1)** • Compares to $y = c + mx$ where the gradient is $-b$ (which is constant) **(1)** **OR** • $\ln V = -bt + \ln 50$ **(1)** • Compares to $y = mx + c$ where the gradient is $-b$ (which is constant) **(1)**	Accept 3.91 for ln 50 MP2 dependent on MP1 Accept 3.91 for ln 50 MP2 dependent on MP1	**2**

<table>
<tr><th>Question Number</th><th>Acceptable Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>3(b)(ii)</td><td>
• Values of ln V correct and consistent to 3 d.p. (1)
• Axes labelled: y as ln (V / cm^3) and x as t / s (1)
• Appropriate scales chosen (1)
• Processed values plotted accurately
[ALL points plotted to ±1 mm] (1)
• Best fit line drawn (1)
</td><td>
[Accept correct and consistent to 2 d.p.]
<table>
<tr><th>V / cm^3</th><th>t / s</th><th>ln (V / cm^3)</th><th>ln (V / cm^3)</th></tr>
<tr><td>45</td><td>8.65</td><td>3.81</td><td>3.807</td></tr>
<tr><td>35</td><td>21.73</td><td>3.56</td><td>3.555</td></tr>
<tr><td>25</td><td>38.91</td><td>3.22</td><td>3.219</td></tr>
<tr><td>15</td><td>67.85</td><td>2.71</td><td>2.708</td></tr>
<tr><td>5</td><td>129.11</td><td>1.61</td><td>1.609</td></tr>
</table>
</td><td>5</td></tr>
<tr><td>3(b)(iii)</td><td>
• Uses large triangle to calculate gradient
[data from table must be on best fit line] (1)
• Value of b in range of 0.018 to 0.019 (1)
• Value of b given to 2 or 3 s.f., positive, with unit of s^{-1} (1)
</td><td>
<u>Example of calculation</u>
$-b = \text{gradient} = \frac{3.88-1.80}{4-118} = \frac{2.08}{-114} = -1.82 \times 10^{-2}$
$b = 1.82 \times 10^{-2}$ s^{-1}
Bald answer can score MP2 / MP3 only
</td><td>3</td></tr>
<tr><td>3(b)(iv)</td><td>
An answer that makes reference to the following points:
• A higher temperature would make the glycerol less viscous (1)
• So the flow rate will increase
Or the time taken (for a given volume to flow) would be shorter (1)
• Therefore the (gradient of the) graph will be steeper
Or the gradient value would be larger (1)
</td><td></td><td>3</td></tr>
</table>

(Total for Question 3 = 14 marks)


4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
ln (V / cm³)
0
20
40
60
80
100
120
140
t / s

Question Number	Acceptable Answer	Additional Guidance	Mark
4(a)	An explanation that makes reference to the following points: • Check and correct for zero error **(1)** • To eliminate/reduce <u>systematic error</u> **(1)**	ONE mark only for "check for zero error to eliminate/reduce <u>systematic error</u>" Do not allow system/systemic. MP2 dependent on MP1	**2**
4(b)(i)	A description that makes reference to the following points: • Clamp the other metre rule **and** check it is vertical with a set square **(1)** • Align the zero with the undeflected metre rule **and** read off the value when the metre rule is deflected **Or** take the readings when the rule is undeflected **and** deflected, **and** subtract the measurements **(1)** • Use a set square to take the measurement perpendicular to the scale **Or** ensure the second metre rule is close to the deflecting metre rule **(1)**	Accept use of plumbline or spirit level Accept sensible suggestion to reduce parallax (e.g. add a pointer to the end of the deflecting metre rule)	**3**
4(b)(ii)	A description that makes reference to the following points: • The resolution (of the half-metre rule) is 1 mm **(1)** • The uncertainty (in a single measurement) is half the resolution (of the rule) **Or** the uncertainty (in each measurement) is 0.5 mm **(1)** • As there are two judgments/measurements the uncertainties are added **Or** as there are two judgments/measurements 0.5 (mm) + 0.5 (mm) = 1 (mm) **(1)**	Do not accept precision/accuracy for resolution. MP3 dependent on MP2	**3**

Question Number	Acceptable Answer	Additional Guidance	Mark
4(c)(i)	• Calculates mean value of w **(1)** • Uses $E = \frac{4MgL^3}{wt^3y}$ **(1)** • E = 1.59×10^{10} (Pa) **(1)**	Example of calculation Mean $w = \frac{(25.07+24.97+25.04+25.01)\text{mm}}{4} = 25.02$ mm $E = \frac{4MgL^3}{wt^3y} = \frac{4 \times 9.81\text{ms}^{-2} \times 0.3982\text{ kg} \times (0.798\text{ m})^3}{25.02\times10^{-3}\text{ m} \times (6.17\times10^{-3}\text{ m})^3 \times 85\times10^{-3}\text{m}}$ $= 1.592 \times 10^{10}$ Pa	**3**
4(c)(ii)	**EITHER** • Uses half range for uncertainty in *w* **(1)** • Uses %U in *L* **or** *w* **or** *t* **or** *y* Accept fractional uncertainty **(1)** • Uses 3×%U in *L* **or** 3×%U in *t* Accept $3 \times \frac{\Delta L}{L}$ or $3 \times \frac{\Delta t}{t}$ **(1)** • %U = 2.7 (%) given to minimum 2 s.f. **(1)** **OR** • Uses maximum and minimum values of *w* **(1)** • Use of uncertainties of *L*, *t*, *y* (and *w*) to calculate maximum **or** minimum E **(1)** • Calculation of half range shown **(1)** • %U = 2.7 (%) given to minimum 2 s.f. **(1)**	Example of calculation Half range $= \frac{(25.07-24.97)\text{mm}}{2} = 0.05$ mm %U in $w = \frac{0.05\text{ mm}}{25.02\text{ mm}} \times 100 = 0.200\%$ %U in $L = \frac{0.001\text{ m}}{0.798\text{ m}} \times 100 = 0.125\%$ %U in $t = \frac{0.02\text{ mm}}{6.17\text{ mm}} \times 100 = 0.324\%$ %U in $y = \frac{1\text{ mm}}{85\text{ mm}} \times 100 = 1.176\%$ %U in *E* = 3 × %U in *L* + %U in *w* + 3 × %U in *t* + %U in *y* = 3 × 0.125% + 0.200% + 3 × 0.324% + 1.176% = 0.375% + 0.200% + 0.972% + 1.176% = 2.72% Example of calculation Max $E = \frac{4MgL^3}{wt^3y} = \frac{4 \times 9.81\text{ms}^{-2} \times 0.3982\text{ kg} \times (0.799\text{ m})^3}{24.97\times10^{-3}\text{ m} \times (6.15\times10^{-3}\text{ m})^3 \times 84\times10^{-3}\text{m}}$ $= 1.634\times10^{10}$ Pa Min $E = \frac{4MgL^3}{wt^3y} = \frac{4 \times 9.81\text{ms}^{-2} \times 0.3982\text{ kg} \times (0.797\text{ m})^3}{25.07\times10^{-3}\text{ m} \times (6.19\times10^{-3}\text{ m})^3 \times 86\times10^{-3}\text{m}}$ $= 1.547\times10^{10}$ Pa U in $E = \frac{1.634 - 1.547}{2} \times 10^{10}$ Pa $= 0.0435 \times 10^{10}$ Pa %U in $E = \frac{0.0435 \times 10^{10}\text{ Pa}}{1.60 \times 10^{10}\text{ Pa}} \times 100 = 2.72$ %	**4**

Question Number	Acceptable Answer	Additional Guidance	Mark
4(c)(iii)	An explanation that makes reference to the following points: **EITHER** • Lower limit of $E = 1.55 \times 10^{10}$ Pa given to minimum 3 s.f. **(1)** • The lower limit of E is greater than 1.23×10^{10} Pa so the metre rule is not made of oak wood **Or** comparison of calculated limit with E with 1.23×10^{10} Pa and consistent conclusion **(1)** **OR** • %D = 29 % **(1)** • As % D is greater than 2.7 % the metre rule is not made of oak wood **Or** comparison of calculated %D with 2.7 % **or** 3 % and consistent conclusion **(1)**	E.c.f. for their % uncertainty from 4(c)(ii) and their value of E from 4(c)(i) Example of calculation Lower limit of $E = 1.59 \times 10^{10}$ Pa $\times (1 - 0.027) = 1.55 \times 10^{10}$ Pa Must see number being compared to. Example of calculation $\%D = \frac{(1.59 - 1.23) \times 10^{10}\ \text{Pa}}{1.23 \times 10^{10}\ \text{Pa}} \times 100 = 29.3\ \%$ Must see number being compared to.	**2**

(Total for Question 4 = 17 marks)
TOTAL FOR PAPER = 50 MARKS