Mark Scheme (Results)

January 2026

Pearson Edexcel International Advanced level
In Physics
Practical Skills in Physics II
WPH16/01A

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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. 'resonance'

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 cm3 × 0.70 g cm-3 = 5040 g

5040 × 10-3 kg × 9.81 N/kg= 49.4 N

5. Graphs

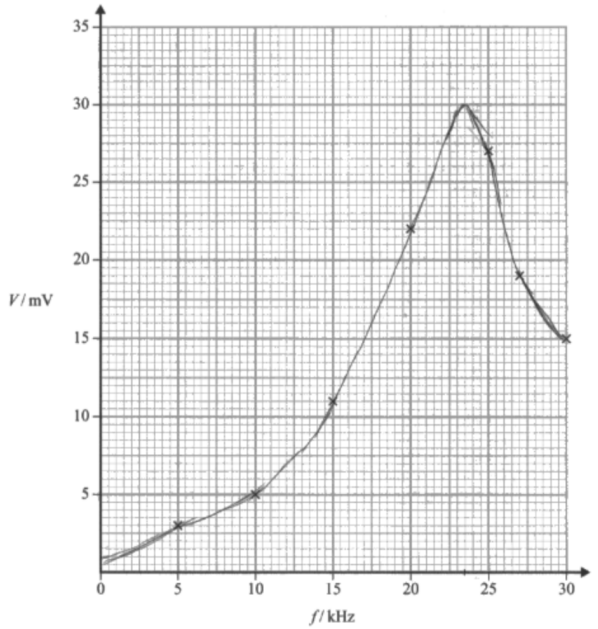
6.1 A mark given for axes requires both axes to be labelled with quantities and units, and drawn the correct way round.

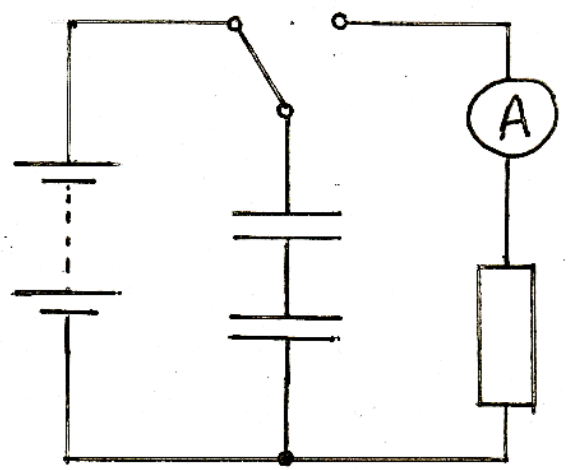
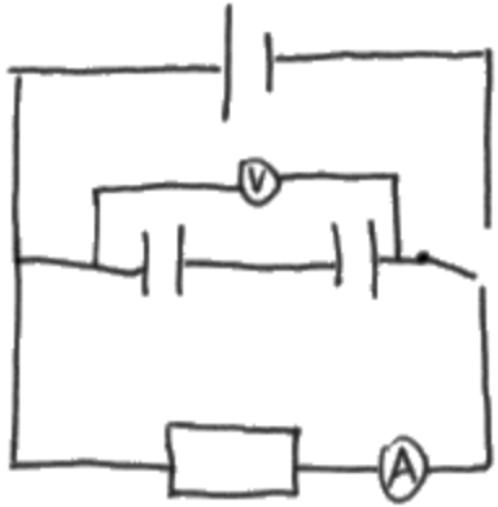
6.2 Sometimes a separate mark will be given for units or for each axis if the units are complex. This will be indicated on the mark scheme.

6.3 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.

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

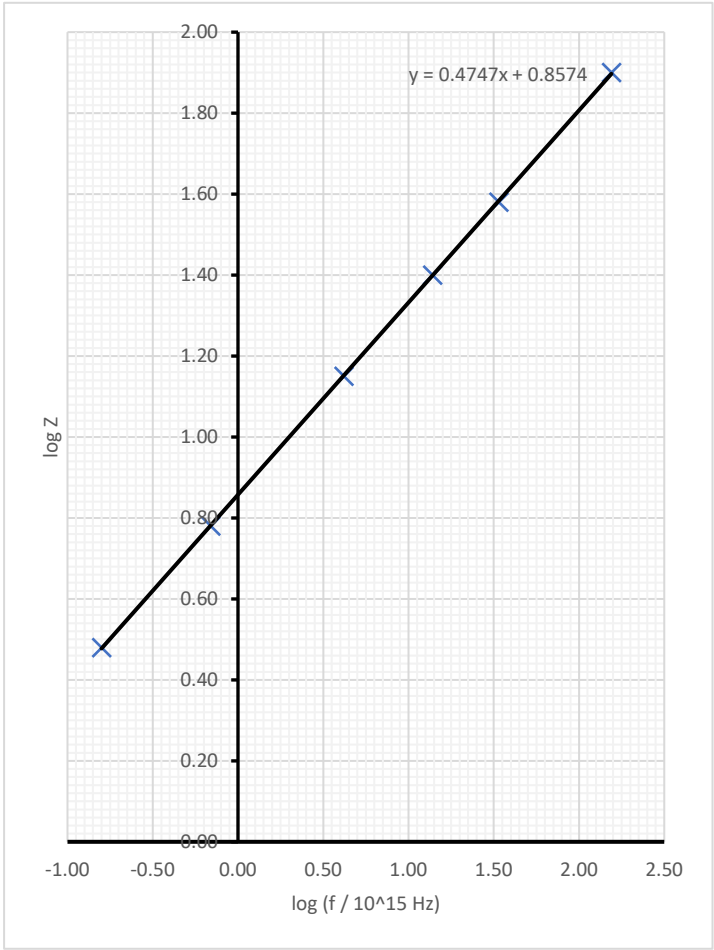
For a line mark there must be a thin continuous line which is the best-fit line for the candidate's results.

Question Number	Answer		Additional Guidance	Mark
1(a)(i)	LoBF is a smooth curve passing close to the points With maximum of curve clearly ≤25 kHz	(1) (1)	Accept two curves that meet in a peak for MP1 Two straight lines that meet, can still gain MP2 and the remaining parts of Q1a Example graph  	2
1(a)(ii)	Max V <35 mV and ≥27 mV	(1)	Value in range and consistent with their peak. Unit required.	1
1(a)(iii)	Peak frequency read correctly	(1)	Value consistent with their peak. Unit required.	1
1(b)	Take more readings (of V and f) near peak **Or** take more readings (of V and f) between 20 and 25 kHz **Or** take more readings at smaller increments	(1)		1
	Total for question 1			5

Question Number	Answer	Additional Guidance	Mark
2(a)	Capacitors connected in series with a d.c. power supply **(1)** Circuit to discharge capacitors through resistor **and** ammeter **(1)** Method of switching between charging and discharging **(1)**	Examples of circuit diagram   	**3**
2(b)	Ensure the working p.d. is not exceeded **Or** ensure the capacitors are (fully) discharged after the experiment **(1)**	Accept reference to capacitor polarity e.g. ensure capacitor is connected to the correct terminals of the power supply	**1**

Question Number	Answer	Additional Guidance	Mark
2(c)	Record current with the ammeter **(1)** Start the stopwatch as soon as the discharge starts **(1)** Keep the ammeter and stopwatch close **Or** Use the lap timer on the stopwatch **(1)** Record corresponding readings of I and t **(1)** Record (at least) 5 sets of readings (at different I) **(1)** Plot the graph of ln I against t and the gradient is −1/RC **(1)**	Alternatives to MP5 & 6 MP5 - Record the time taken for the initial current to halve **Or** record the time taken for the initial current to reach 37% MP6 -Calculate C using $t_{½} = RC \ln 2$ **Or** calculate C using time constant = RC	**6**
2(d)	Readings (of current and time) can be taken simultaneously **(1)** Many readings (of current and time) can be taken in a short time **Or** readings (of current and time) taken at a higher sample rate **(1)**		**2**
	Total for question 2		**12**

Question Number	Answer		Additional Guidance	Mark
3(a)	**EITHER**			
	$\log Z = \log k + n \log f$	**(1)**		
	Is in the form $y = c + mx$ **and** gradient = n which is constant	**(1)**	MP2 dependent on MP1	
	OR			
	$\log Z = n \log f + \log k$	**(1)**		**2**
	Is in the form $y = mx + c$ **and** gradient = n which is constant	**(1)**	MP2 dependent on MP1	

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>3(b)(i)</td><td>
Values of log Z correct to 2 d.p. (1)
Values of log (f/10^{15} Hz) correct to 2 d.p. (1)
Axes labelled: y as log Z and x as log (f/ 10^{15}Hz) for log values
Or axes labelled: y as ln Z and x as ln (f/ 10^{15}Hz) for ln values (1)
Appropriate scales chosen (1)
log values plotted accurately (1)
Best fit line drawn (1)
<table>
<tr><th>log Z</th><th>log (f / 10^{15} Hz)</th><th>log (f / Hz)</th><th>ln Z</th><th>ln (f / 10^{15} Hz)</th><th>ln (f / Hz)</th></tr>
<tr><td>0.48</td><td>–0.80</td><td>14.20</td><td>1.10</td><td>–1.83</td><td>32.71</td></tr>
<tr><td>0.78</td><td>–0.16</td><td>14.84</td><td>1.79</td><td>–0.37</td><td>34.17</td></tr>
<tr><td>1.15</td><td>0.62</td><td>15.62</td><td>2.64</td><td>1.43</td><td>35.97</td></tr>
<tr><td>1.40</td><td>1.14</td><td>16.14</td><td>3.22</td><td>2.63</td><td>37.16</td></tr>
<tr><td>1.58</td><td>1.53</td><td>16.53</td><td>3.64</td><td>3.53</td><td>38.06</td></tr>
<tr><td>1.90</td><td>2.19</td><td>17.19</td><td>4.38</td><td>5.04</td><td>39.58</td></tr>
</table>
</td><td>
Accept ln values, 2 d.p.
Accept ln values, 2 d.p.


</td><td>6</td></tr>
<tr><td>3(b)(ii)</td><td>
Uses large triangle (1)
Value of n in range 0.45 to 0.50 (1)
Calculated n given to 2 or 3 s.f., no unit (1)
</td><td>
<u>Example of calculation</u>
n = (1.92 - 0.5) / (2.25 - -0.75) = 1.42 / 3 = 0.47
</td><td>3</td></tr>
</table>

Question Number	Answer	Additional Guidance	Mark
3(b)(iii)	Correct value of y intercept from graph **Or** value of y intercept calculated from $y = mx + c$ **(1)** Value of k in range 6.9 to 7.3 **(1)** Value of k given to 2 or 3 s.f. **(1)**	MP1 Accept log Z axis intercept if axes reversed Accept use of 2 data points from the line, and $Z = kf^n$ or $\log Z = n \log f + \log k$ as simultaneous equations Accept use of 1 data point from the line and their value of n, in $Z = kf^n$ or $\log Z = n \log f + \log k$ <u>Example of calculation</u> Log $k = 0.86$ $k = 10^{0.86} = 7.24$	**3**
3(c)	**EITHER** A graph of log Z against log f would be a straight line with a gradient of 0.5 **(1)** Conclusion based on comparison of gradient (n) with 0.5 **(1)** **OR** States mathematical relationship using calculated values of n (and k) **(1)** Conclusion based on comparison with $Z \propto f^{0.5}$ **(1)**	e.g. $\log Z = 0.5 \log f + \log k$ and identifies that the gradient (n) would be 0.5 and calculated n (0.48) $\simeq$ 0.5, so graph supports the suggestion e.g. substitutes their k and n values into $Z = kf^n$, and identifies that k is a constant (so $Z \propto f^n$) and calculated n (0.48) $\simeq$ 0.5, so graph supports the suggestion	**2**
	Total for question 3		**16**

Question Number	Answer		Additional Guidance	Mark
4(a)(i)	**EITHER**			
	Repeat at different orientations and calculate a mean	**(1)**	Accept different places, positions, etc	
	To reduce (the effect of) <u>random error</u>	**(1)**	MP2 dependent MP1 Allow one mark for "Repeat and calculate a mean to reduce random error".	
	OR			
	Check and correct for zero error	**(1)**	Accept suitable method	
	To eliminate/reduce <u>systematic error</u>	**(1)**	MP2 dependent MP1 Allow one mark for "Check for zero error to eliminate/reduce systematic error".	**2**
4(a)(ii)	Mean d = 8.54 (mm) to 2 d.p.	**(1)**		
	Calculation using half range shown **Or** calculation of furthest from mean	**(1)**		
	Uncertainty in d = 0.02 (mm)	**(1)**	Uncertainty d.p. should be consistent with mean <u>Example of calculation</u> Mean d = (8.53 + 8.56 + 8.55 + 8.53) / 4 = 34.17 / 4 = 8.54 (mm) Uncertainty = (8.56 – 8.53) / 2 = 0.03 / 2 = 0.015 = 0.02 (mm)	**3**

Question Number	Answer		Additional Guidance	Mark
4(b)(i)	**EITHER** Use of %U in $d = \frac{\Delta d}{d}$ (× 100%) Calculation of U in $d^2 = 2 \times$ %U in d U in d^2= 1.3 (mm^2) **OR** Uses uncertainty in d to calculate minimum or maximum d^2 Calculation of U in d^2 using half range U in d^2= 1.3 (mm^2)	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	<u>Example of calculation</u> %U in d = (0.06 / 10.07) × 100 = 0.56 % %U in d^2 = 2 × 0.56 % = 1.1 % d^2 = (10.07 mm)^2 = 115 mm^2 U in d^2= 115 mm^2 × 1.1 % = 1.3 mm^2 <u>Example of calculation</u> Maximum d^2 = (10.70 + 0.06)^2 = 10.76^2 = 115.8 (mm^2) Minimum d^2 = (10.70 – 0.06)^2 = 10.64^2 = 113.2 (mm^2) U in d^2= $\frac{115.8-113.2}{2} = \frac{2.6}{2}$ = 1.3 (mm^2)	**3**

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)	**EITHER** Use of $A = \frac{\pi}{4}(s^2 - d^2)$ **(1)** Addition of uncertainties in s^2 and d^2 **(1)** Calculation of U in A using factor of $\frac{\pi}{4}$ shown **(1)** %U in A = 0.43 % **(1)** (use of "show that" value of U in d^2 of ±1mm^2 gives 0.39%) **OR** Use of $A = \frac{\pi}{4}(s^2 - d^2)$ **(1)** Correct use of uncertainties to calculate maximum or minimum A **(1)** Calculation of U in A from half range shown **(1)** %U in A = 0.43 % **(1)** (use of "show that" value of U in d^2 of ±1mm^2 gives 0.39%)	e.c.f. U d^2 in 4(b)(i) Example of calculation $A = \frac{\pi}{4}(s^2 - d^2) = \frac{\pi}{4}(881 - 114) = \frac{\pi}{4} \times 766 = 602$ mm^2 U in $A = \frac{\pi}{4}(2 + 1.3) = \frac{\pi}{4} \times 3.3 = 2.6$ mm^2 %U in $A = \frac{2.6}{602} \times 100 = 0.43$ % e.c.f. U d^2 4(b)(i) Example of calculation $A = \frac{\pi}{4}(s^2 - d^2) = \frac{\pi}{4}(881 - 114) = \frac{\pi}{4} \times 767 = 602$ mm^2 Max $A = \frac{\pi}{4}(s^2 - d^2) = \frac{\pi}{4}((881 + 2) - (10.7^2 - 1.3)) = \frac{\pi}{4} \times 770$ = 604.6 mm^2 Min $A = \frac{\pi}{4}(s^2 - d^2) = \frac{\pi}{4}((881 - 2) - (10.7^2 + 1.3)) = \frac{\pi}{4} \times 763$ = 599.4 mm^2 U in $A = \frac{604.6 - 599.4}{2} = 2.6$ mm^2 %U in $A = \frac{2.6}{602} \times 100 = 0.43$ %	**4**
4(c)(i)	Use of $\rho = \frac{m}{xA}$ **(1)** ρ = 7.46 g cm^{-3} (3 s.f. only) **(1)**	Example of calculation $\rho = \frac{63}{1.403 \times 6.02} = 7.46$ (g cm^{-3})	**2**

Question Number	Answer		Additional Guidance	Mark
4(c)(ii)	**EITHER**			
	%U in ρ = 1.5 %	**(1)**	Accept 1, 2 or 3 sig figs	
	Correct calculation of relevant limit using %U in ρ	**(1)**	e.c.f. 4(c)(i)	
	Conclusion based on comparison of limit and range	**(1)**	MP3 dependent MP2	
			Example of calculation	
			%U in $\rho = \frac{0.5}{63} \times 100 + \frac{0.04}{14.03} \times 100 + 0.4 = 0.8\ \% + 0.3\ \% + 0.4\ \% = 1.5\ \%$	
			Upper limit of $\rho = 7.46 \times (1 + 0.015) = 7.57$ (g cm^{-3})	
			As the upper limit is higher than 7.48 g cm^{-3} then the ring could be made from stainless steel.	
	OR			
	%U in ρ = 1.5 %	**(1)**	Accept 1, 2 or 3 sig figs	
	Correct calculation of relevant %D shown	**(1)**	e.c.f. 4(c)(i)	
	Conclusion based on comparison of %D and %U in ρ	**(1)**	MP3 dependent MP2	
			Example of calculation	
			%U in $\rho = \frac{0.5}{63} \times 100 + \frac{0.04}{14.03} \times 100 + 0.4 = 0.8\ \% + 0.3\ \% + 0.4\ \% = 1.5\ \%$	
			%D = $\frac{7.48-7.46}{7.48} \times 100 = 0.3\ \%$	
			As % D for the lower value is less than the %U then the ring could be made from stainless steel.	
	OR			
	Use of $\rho = \frac{m}{xA}$ and uncertainties to calculate maximum or minimum ρ	**(1)**	Note minimum ρ = 7.35 (g cm^{-3})	
	Correct calculation of relevant limit shown	**(1)**	e.c.f. 4(c)(i)	
	Conclusion based on comparison of relevant limit and range	**(1)**	MP3 dependent MP2	**3**
			Example of calculation	
			Maximum $\rho = \frac{63+0.5}{(1.403-0.004)\times(6.02-0.4\%)} = \frac{63.5}{1.399\times6.00} = \frac{63.5}{8.39} = 7.56$ (g cm^{-3})	
			As the maximum ρ is higher than 7.48 g cm^{-3} then the ring could be made from stainless steel.	
	Total for question 4			**17**