Pearson

Mark Scheme (Results)

October 2025

Pearson Edexcel International Advanced Subsidiary level In Physics
WPH16/01A

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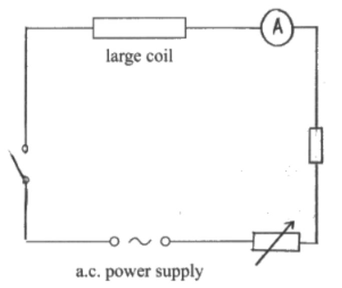
General Marking Guidance

- 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.

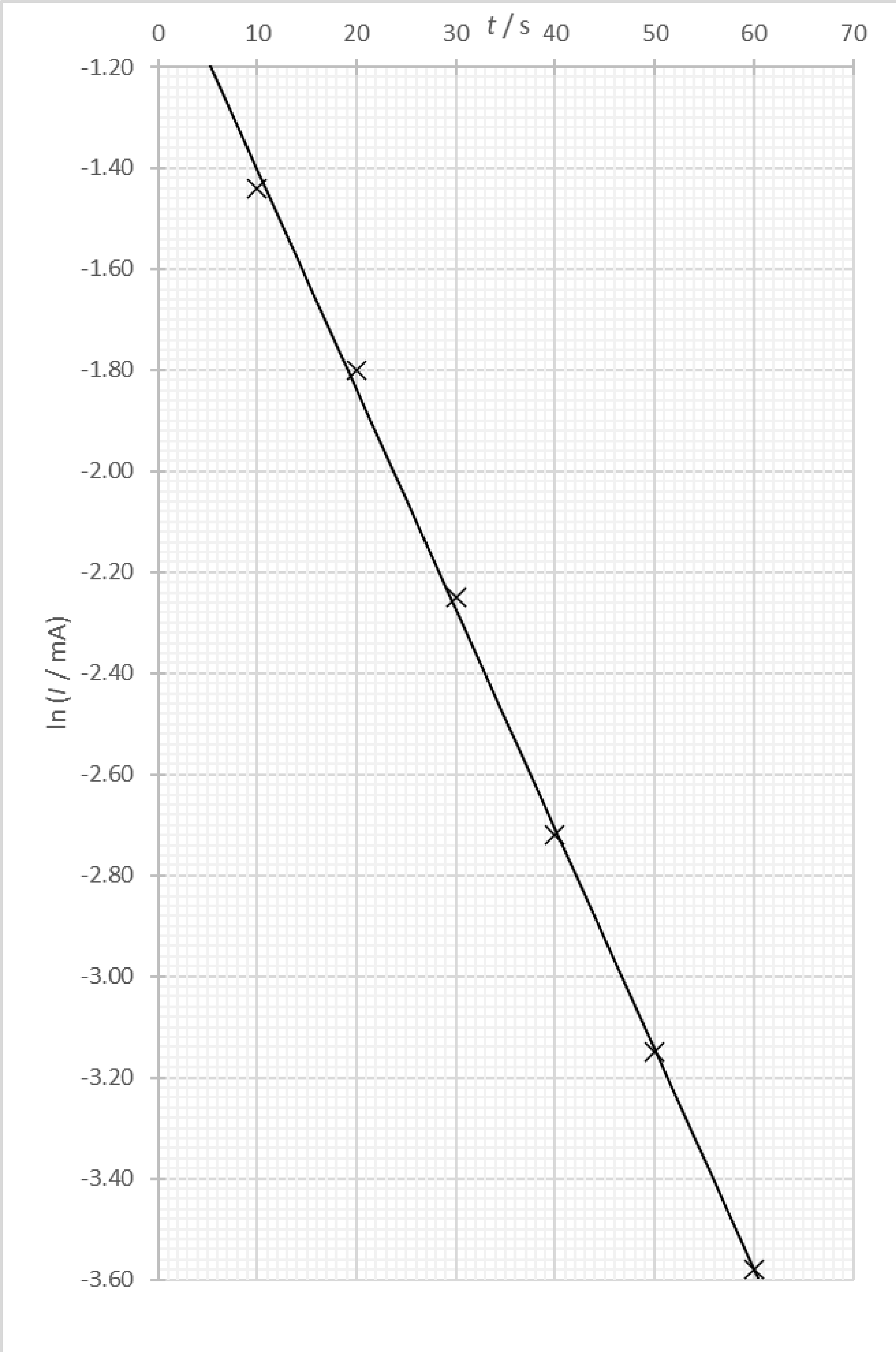
Question Number	Answer		Additional Guidance	Mark
1(a)(i)	• Use a (timing) marker at the centre of the oscillation • Start timing after several oscillations **Or** Use a small initial displacement	(1) (1)		2
1(a)(ii)	• A video camera can view/record in slow motion • So judging where/when a whole oscillation is complete is more accurate MP2 dependent on MP1	(1) (1)		2
1(b)(i)	• Calculation of mean $5T$ • Mean $T = 1.04$ s given to 2 d.p.	(1) (1)	<u>Example of calculation</u> Mean $5T = \frac{(5.25 + 5.16 + 5.21 + 5.19)\text{ s}}{4} = 5.203$ s Mean $T = \frac{5.20\text{ s}}{5} = 1.041$ s	2
1(b)(ii)	• Uses half range **Or** Uses furthest value from the mean • Percentage uncertainty = 0.9% e.c.f. (b)(i) accept 1 or 2 s.f.	(1) (1)	<u>Example of calculation</u> Half range in $5T = \frac{(5.25 - 5.16)\text{ s}}{2} = 0.045$ s Percentage uncertainty $= \frac{0.045\text{ s}}{5.20\text{ s}} \times 100$ $= 0.87\% = 0.9\%$	2
1(c)	Any **TWO** from: • There are no units for mass • There are not enough points (to draw an accurate best fit line) • There is an inconsistent value of T at mass of 1.8 • The mass should be recorded to more decimal places • No evidence of repeats	(1) (1) (1) (1) (1)	Ignore references to intervals and range	2
	Total for question 1			**10**

Question Number	Answer	Additional Guidance	Mark
2(a)	• Determines number of divisions for (half) amplitude **(1)** • Calculates number of divisions × 5 (mV) per division **(1)** • e.m.f. induced = 18.5 mV accept rounded to 19 mV **(1)**	<u>Example of calculation</u> Number divisions = $\frac{4+3.4}{2} = 3.7$ e.m.f induced = 3.7 × 5 mV = 18.5 mV	3
2(b)(i)	• Ammeter connected in series with large coil **(1)** • Means of varying current, e.g. variable resistor, potentiometer **(1)**	<u>Example of circuit</u> 	2
2(b)(ii)	• Measure x with a (metre) rule **(1)** • Count the number of turns N (on the large coil) **(1)** • x **and** N are (kept) constant **Or** The distance between the coils is (kept) constant **(1)** • Record I and the corresponding value of V **(1)** • (Vary I) and record at least 5 different sets of values **(1)** • Plot graph of V against I and gradient is $\frac{zN}{x}$ **(1)**	Do not accept 5 sets of values for repeating and calculating a mean Accept alternative valid graphs	6
	Total for question 2		**11**

Question Number	Answer	Additional Guidance	Mark
3(a)	Any **TWO** from: • Do not exceed the working p.d. of the capacitor **(1)** • Connect the capacitor with the correct polarity **(1)** • Discharge the capacitor (fully) before handling **(1)**	May refer to + or −	**2**
3(b)(i)	**EITHER** • $\ln I = \ln I_0 - \frac{t}{RC}$ **(1)** • Compares to $y = c + mx$ where the gradient is $-\frac{1}{RC}$ (which is constant) **(1)** MP2 dependent on MP1 **OR** **(1)** • $\ln I = -\frac{t}{RC} + \ln I_0$ • Compares to $y = mx + c$ where the gradient is $-\frac{1}{RC}$ (which is constant) **(1)** MP2 dependent on MP1	Do not accept "m" for gradient Do not accept "m" for gradient	**2**
3(b)(ii)	• Values of ln I correct and consistent to 3 d.p. Accept correct and consistent to 2 d.p. **(1)** • Axes labelled: y as ln (I/mA) and x as t / s **(1)** • Appropriate scales chosen for both axes **(1)** • Processed values plotted accurately **(1)** • Reasonable best fit line drawn **(1)**	see table below	**5**

t / s	I /mA	ln(I /mA)	ln(I /mA)
10.00	0.237	–1.440	–1.44
20.00	0.165	–1.802	–1.80
30.00	0.105	–2.254	–2.25
40.00	0.066	–2.718	–2.72
50.00	0.043	–3.147	–3.15
60.00	0.028	–3.576	–3.58

3(b)(iii)	• Uses large triangle to calculate gradient • Uses gradient $= -\frac{1}{RC}$ • R in range 3.25×10^4 (Ω) to 3.42×10^4 (Ω) • Calculated value of R given to 2 or 3 s.f. with unit Ω	**(1)** **(1)** **(1)** **(1)**	<u>Example of calculation</u> $\text{gradient} = \frac{-1.40 - -3.40}{10 - 56} = \frac{2.00}{-46} = -0.0435$ $R = -\frac{1}{\text{gradient} \times C} = -\frac{1}{-0.0435 \times 680 \times 10^{-6}}$ $= 33806\ \Omega = 33.8\ \text{k}\Omega$	**4**



t / s
0
10
20
30
40
50
60
70
ln (I / mA)
-1.20
-1.40
-1.60
-1.80
-2.00
-2.20
-2.40
-2.60
-2.80
-3.00
-3.20
-3.40
-3.60

3(c)	**EITHER** • Data logger can take simultaneous readings **(1)** • So the readings/value will be closer to the true value **Or** So there will be less uncertainty in the readings **(1)** MP2 dependent on MP1 **OR** • Data logger has a high sampling rate **(1)** • So there will be less uncertainty in the best-fit line **(1)** MP2 dependent on MP1		**2**
	Total for question 3		**15**

Question Number	Answer		Additional Guidance	Mark
4(a)	• Adjust the position of the bridge slowly to determine the maximum amplitude **Or** Place a piece of card behind the wire (to judge position of maximum amplitude) • Use a metre rule (to measure L) • Align the zero of the metre rule with the (right hand) edge of the blocks **Or** Take readings at the (right hand) edge of the blocks and the bridge, and subtract the two readings • Move the bridge to determine L several times to calculate a mean L.	**(1)** **(1)** **(1)** **(1)**	Accept incrementally for slowly Accept ruler, tape measure Must be referring to the whole process of finding the maximum amplitude	4
4(b)	**EITHER** • Repeat at different positions/orientations (along the wire) and calculate a mean • To reduce (the effect of) <u>random errors</u> MP2 dependent on MP1 **OR** • Check and correct for zero error • To eliminate/reduce <u>systematic error</u> MP2 dependent on MP1	**(1)** **(1)** **(1)** **(1)**	Allow 1 mark for "Repeat and calculate a mean to reduce (the effect of) <u>random errors</u>" Allow 1 mark for "Check for zero error to eliminate/reduce <u>systematic error</u>" Allow 1 mark for avoiding overtightening the micrometer if no other mark awarded	2
4(c)(i)	• Uses $L^2 = \frac{Mg}{\pi \rho d^2 f^2}$ • ρ = 8090 (kg m^{-3}) to at least 3 s.f.	**(1)** **(1)**	<u>Example of calculation</u> $\rho = \frac{Mg}{\pi d^2 f^2 L^2} =$ $\frac{0.802 \text{ kg} \times 9.81 \text{ m s}^{-2}}{\pi \times (1.02 \times 10^{-3} \text{ m})^2 \times (50.3 \text{ Hz})^2 \times (0.343 \text{ m})^2}$ = 8087 (kg m^{-3})	2

4(c)(ii)	**EITHER** • Uses half resolution for %U in f Accept fractional uncertainty (1) • Uses 2 × %U in d **Or** Uses 2 × %U in L **Or** Uses 2 × %U in f Accept 2 × fractional uncertainty (1) • Adds percentage uncertainty in all three variables (1) • Correct %U given to 2 s.f. (1) **OR** • Uses half resolution for uncertainty in f (1) • Uses uncertainties to calculate maximum in ρ **Or** Uses uncertainties to calculate minimum in ρ (1) • Calculation of half range shown (1) • Correct %U given to to 2 s.f. (1)	(1) (1) (1) (1) (1) (1) (1) (1)	Example of calculation %U in $d = \frac{0.02\text{ mm}}{1.02\text{ mm}} \times 100 = 1.96\ \%$ %U in $f = \frac{0.05\text{ Hz}}{50.3\text{ Hz}} \times 100 = 0.099\ \%$ %U in $L = \frac{0.003\text{ m}}{0.343\text{ m}} \times 100 = 0.87\ \%$ %U in ρ = 2×%U in d + 2× %U in f + 2×%U in l = 2 × 1.96% + 2 × 0.099% + 2 × 0.87% = 5.9% Example of calculation Maximum $\rho = \frac{Mg}{\pi d^2 f^2 L^2} = \frac{0.802\text{ kg} \times 9.81\text{ m s}^{-2}}{\pi \times (1.00 \times 10^{-3}\text{ m})^2 \times (50.25\text{ Hz})^2 \times (0.340\text{ m})^2}$ = 8580 (kg m^{-3}) Minimum $\rho = \frac{Mg}{\pi d^2 f^2 L^2} = \frac{0.802\text{ kg} \times 9.81\text{ m s}^{-2}}{\pi \times (1.04 \times 10^{-3}\text{ m})^2 \times (50.35\text{ Hz})^2 \times (0.346\text{ m})^2}$ = 7629 (kg m^{-3}) %U in $\rho = \frac{(8580 - 7629)\text{ kg m}^{-3}}{2 \times 8090\text{ kg m}^{-3}} \times 100 = 5.9\%$	**4**

4(c)(iii)	**EITHER** • Calculates relevant limit of calculated ρ using %U e.c.f. (c)(i), (c)(ii) **(1)** • Conclusion based on comparison of limit to 7800 kg m^{-3} **(1)** "Show that" values give lower limit = 7614 (kg m^{-3}) **OR** • Calculates %D with 7800 kg m^{-3} as the denominator e.c.f. (c)(i), (c)(ii) **(1)** • Conclusion based on comparison of %D to 6% **(1)** **Or** Conclusion based on comparison of %D to stated calculated %U "Show that" values give %D = 3.8%	<u>Example of calculation</u> Lower limit of ρ = 8090 (kg m^{-3}) × (1 – 0.059) = 7612 (kg m^{-3}) This lower limit is less than 7800 kg m^{-3} so the wire could be made of stainless steel <u>Example of calculation</u> $\%D = \frac{(8090 - 7800)\ \text{kg m}^{-3}}{7800\ \text{kg m}^{-3}} \times 100 = 3.7\%$ As %D is less than 5.9%, the wire could be made from stainless steel	2
	Total for question 4		**14**