Mark Scheme (Results)

January 2017

Pearson Edexcel International Advanced Level
in Physics (WPH06)
Paper 01 Experimental Physics

January 2017
Publications Code WPH06_01_MS_1701*

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

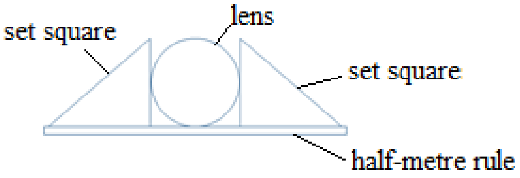
4.1 Bald (i.e. no working shown) correct answers score full marks unless in a 'show that' question.

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.

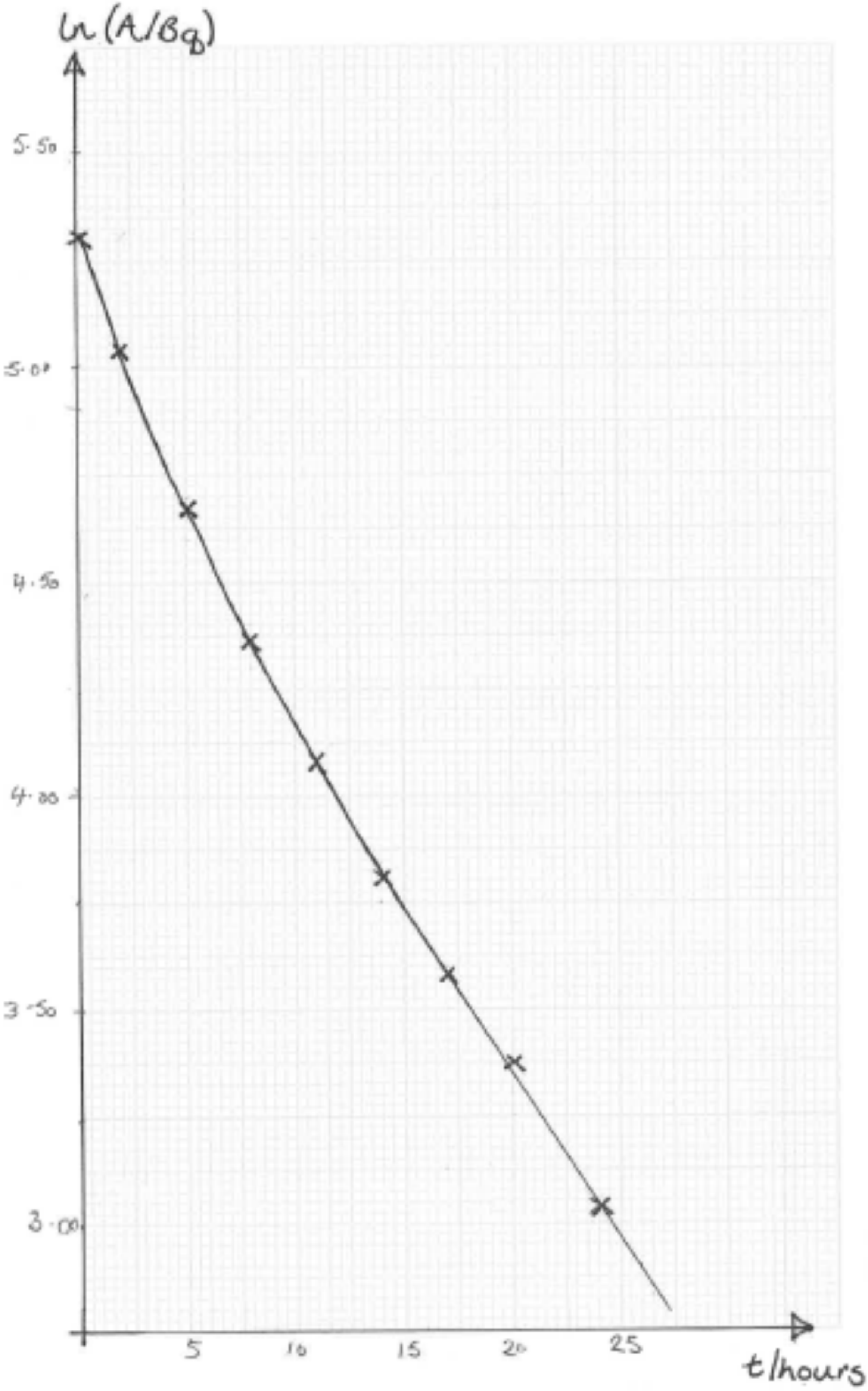
4.5 The mark scheme will show a correctly worked answer for illustration only.

Question Number	Answer	Mark
1(a)(i)	Lens placed on half-metre rule with base of set squares against bottom edge of rule and sides of set squares against edge of lens. (1) 	**1**
1(a)(ii)	Measure the diameter in different orientations. (1) (this may be shown on the diagram drawn for (a)(i) or the printed diagram)	**1**
1(a)(iii)	Percentage uncertainty in *d* = 2.6 % (accept 3% or 2.56%) (1) <u>Example of calculation</u> $\%\text{U} = \frac{\Delta d}{d} \times 100\ \%$ $\%\text{U} = \frac{0.1}{3.9} \times 100 = 2.6\ \%$	**1**
1(b)(i)	Percentage uncertainty in *t* = 3.8 % (accept 4% or 3.85%) (1) <u>Example of calculation</u> Percentage uncertainty in *t* = $\frac{\Delta t}{t} \times 100\% = \frac{0.01}{0.26} \times 100\% = 3.8\%$	**1**
1(b)(ii)	Correct substitution into $f = \frac{d^2}{8t(\mu-1)}$ (1) *f* = 14 (cm) (1) Answer to 2 s.f. with correct unit (1) <u>Example of calculation</u> $f = \frac{d^2}{8t(\mu - 1)} = \frac{3.9^2}{8 \times 0.26(1.52 - 1)} = 14.1\text{ cm}$	**3**
1(b)(iii)	Add % uncertainties from their values in (a)(iii) and (b)(i) (1) % U = 9.0 % (accept 10% or 8.97%) (1) <u>Example of calculation</u> $\%\text{U in } f = 2 \times \%\text{U in } d + \%\text{U in } t = 2 \times 2.6 + 3.8 = 9.0\ \%$	**2**
1(b)(iv)	Uncertainty in *f* = 1.3 cm (accept 1.4 cm) (1) ecf value from (b)(ii) and (b)(iii) <u>Example of calculation</u> $\text{U} = f \times \%\text{U in } f = 14 \times 9.0/100 = 1.26\text{ cm}$	**1**
1(b)(v)	*d* contributes the most to the uncertainty (1) because its percentage uncertainty is doubled (1) **Or** because *d* is squared in equation (dependent on MP1)	**2**
	Total for Question 1	**12**

Question Number	Answer		Mark
2(a)	Use of a fiducial marker for counting rotations Measure the time for several rotations **and** divide by number of rotations to determine T. Repeat **and** calculate a mean.	(1) (1) (1)	**3**
2(b)(i)	Use of $\omega = \frac{2\pi}{T}$ Correct re-arrangement for T^2.	(1) (1)	**2**
2(b)(ii)	Plot T^2 against $\frac{1}{M}$. **(**accept other combination of these variables that will produce a straight line)	(1)	**1**
2(c)	String taut/straight Measure from end of tube to the centre of the bung with mark at bottom of tube **Or** Measure from mark to centre of bung and subtract length of tube	(1) (1)	**2**
2(d)	Risk and corresponding precaution E.g. Bung may hit experimenter so wear goggles **Or** Bung may hit someone so carry out investigation in open space. **Or** Mass may fall so wear foot protection.	(1)	**1**
	Total for Question 2		**9**

Question Number	**Answer This question is to be marked holistically**	**Mark**
3(a)	Ammeter and d.c power supply (1) Variable resistor **Or** variable power supply (1)	**2**
3(b)	Components connected in series with the copper rod to give a workable circuit (1)	**1**
3(c)	Magnet placed on top of top-pan balance and rod suspended between poles (1) Field between the poles of the magnet perpendicular to the copper rod. (1)	**2**
3(d)	Take the initial reading on the top-pan balance **Or** check zero error on balance (1) (Switch on the current and) take the ammeter reading and new reading on the top-pan balance. (1) Multiply mass by *g* to give force (1)	**3**
3(e)	Graph of force against current - straight line through origin shown (1)	**1**
	Total for Question 3	**9**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>4(a)</td><td>Show ln version of equation $\ln A = \ln A_0 - \lambda t$ (1)
Compare to $y = mx + c$ and clear link between m and (-) λ (1)</td><td>2</td></tr>
<tr><td>4(b)(i)</td><td>ln values correct in table as shown below to 3 s.f. (1)
Axes labelled with quantities and units (1)
Scales (1)
Plots (1)
Line of best fit (should be a shallow curve) (1)
<table>
<tr><th>A/Bq</th><th>T / hours</th><th>ln (A/Bq)</th></tr>
<tr><td>200</td><td>0</td><td>5.30</td></tr>
<tr><td>153</td><td>2</td><td>5.03</td></tr>
<tr><td>107</td><td>5</td><td>4.67</td></tr>
<tr><td>78</td><td>8</td><td>4.36</td></tr>
<tr><td>59</td><td>11</td><td>4.08</td></tr>
<tr><td>45</td><td>14</td><td>3.81</td></tr>
<tr><td>36</td><td>17</td><td>3.58</td></tr>
<tr><td>29</td><td>20</td><td>3.37</td></tr>
<tr><td>21</td><td>24</td><td>3.04</td></tr>
</table></td><td>5</td></tr>
<tr><td>4(b)(ii)</td><td>Use of triangle between at least $t = 16$ and $t = 23$ (1)
Value of gradient between (-)0.073 and (-)0.080 (1)
Value of λ positive to 2 s.f. and unit $(\text{hour})^{-1}$ (1)</td><td>3</td></tr>
<tr><td></td><td>Total for Question 4</td><td>10</td></tr>
</table>


ln (A/Bq)
5.50
5.00
4.50
4.00
3.50
3.00
5
10
15
20
25
t/hours

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