Mark Scheme (Results)

Summer 2017

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

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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 veing rewarded, backed up by examples. It is not a set of model answers.

For example:

(iii) <u>Horizontal force of hinge on table top</u>

66.3 (N) or 66 (N) **and** correct indication of direction [no ue] **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 sugn in front of number as direction.]

This has a clear statement of the principle of 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 mark scheme has the 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 advise 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 cause the final calculation mark to be lost.

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

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

2.4 The same missing or incorrect unit will not be penalised more than once within a question.

2.5 Occasionally, it may be decided not to penalise a missing or incorrect 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 penalty is to be applied by means of [no ue].

3. Significant figures

Use of an inappropriate numberof 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.

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 candidates demonstrates subsistution 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.

4.6 Example of mark scheme for a calculation:

<u>'Show that' calculation of weight</u>

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**

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

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

<u>Example of answer:</u>

80 cm × 50 cm × 1.8 cm = 7200 cm^3

7200 cm^3 × 0.70 g cm^{-3} = 5040 g

5040 × 10^{-3} kg × 9.81 N/kg = 49.4 N

5. Quality of Written Communication

5.1 Indicated by QoWC in mark scheme. QWC – Work must be clear and organised in a logical manner using technical wording where appropriate.

5.2 Usually it is part of the max mark.

6. Graphs

6.1 A mark 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, 4, 7 etc.

6.4 Points should be plotted to within 1 mm.

- Check the two furthest from the best line. If both OK award mark.
- If either is 2 mm out do not award mark.
- If both are 1 mm out do not award mark.
- If either is 1 mm out then check another two and award mark if both of these OK, otherwise no mark.

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

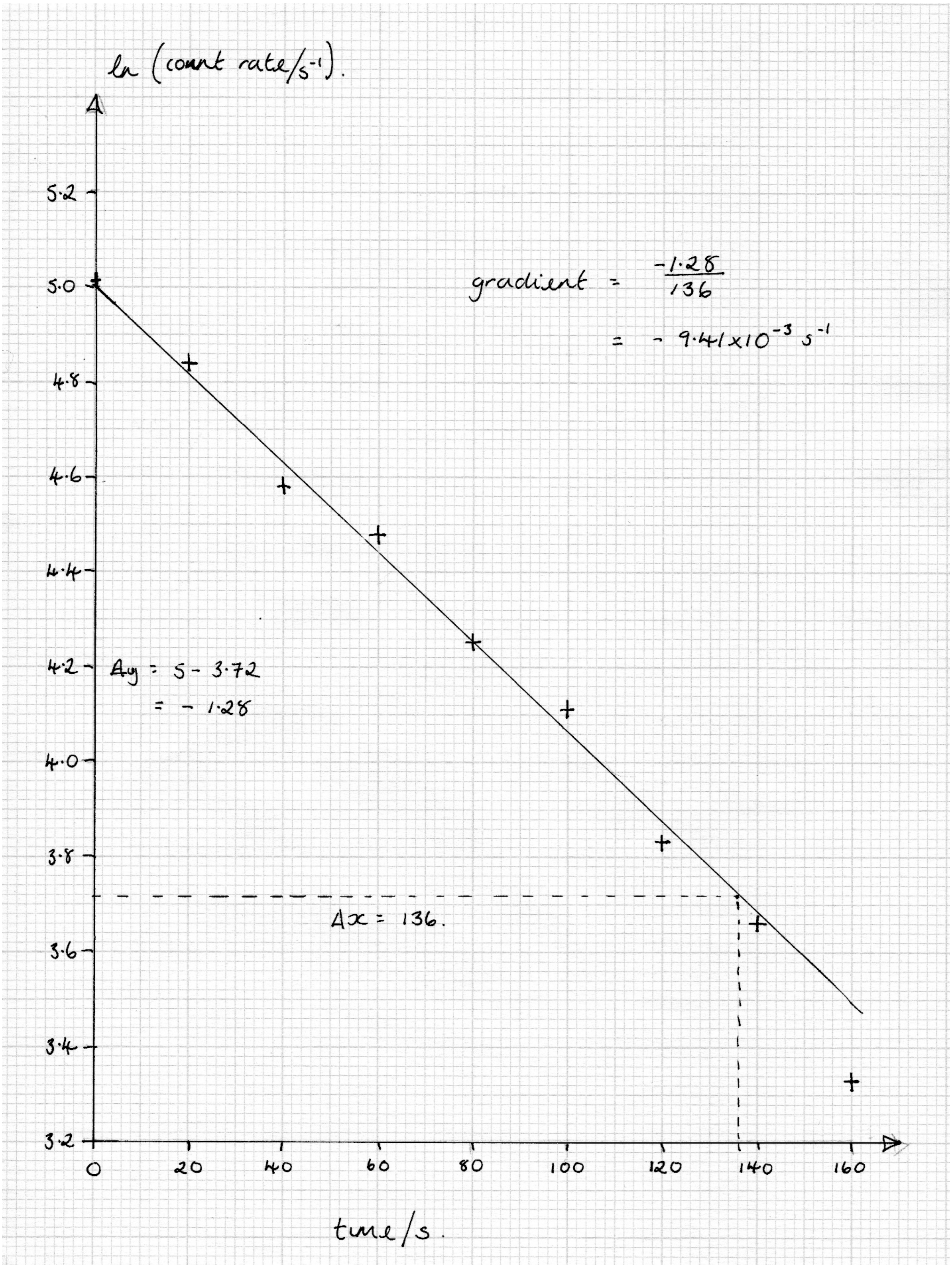
Question Number	Answer		Mark
1(a)(i)	Vernier/digital calipers	(1)	**1**
1(a)(ii)	(Vernier calipers) have a precision of 0.1 mm/0.01 mm So (expected) percentage uncertainty of 1 %/0.1 % is small	(1) (1)	 **2**
1(a)(iii)	**Any one from** Check for zero error Take (multiple) readings at different orientations **and** determine a mean	(1)	**1**
1(b)	% uncertainty = 0.3 % [accept 0.30 % or 0.302 %] Example of calculation 0.003 / 0.995 × 100 = 0.302 %	(1)	**1**
1(c)(i)	See units for V/t as $m^3\ s^{-1}$ **and** L as m See units for P as $N\ m^{-2}$ **and** r^4 as m^4 **Or** Rearranges Stokes' law $\eta = F/6\pi rv$ See F in N, r in m **and** v in $m\ s^{-1}$	(1) (1) (1) (1)	 **2**
1(c)(ii)	Use of $\eta = \frac{\pi r^4 Pt}{8LV}$ $\eta = 9.8 \times 10^{-3}$ ($N\ s\ m^{-2}$) [accept 9.83×10^{-3}] Example of calculation $\eta = \frac{\pi \times (0.5 \times 0.995 \times 10^{-2})^4 \times 695}{8 \times 2 \times 8.5 \times 10^{-6}} = 0.00983$	(1) (1)	 **2**
1(c)(iii)	4 × % uncertainty in d % uncertainty = 5.9% [accept 6 %] [allow ecf from (b) to 1/2 s.f.] Example of calculation (4 × 0.3) + 3.5 + 0.7 + 0.5 = 5.9%	(1) (1)	 **2**
	Total for Question 1		**11**

Question Number	Answer	Mark
2(a)	Use the pin/marker at the midpoint/equilibrium point (1) Record nT **and** divide by n (1) Repeat **and** calculate the mean (1)	**3**
2(b)(i)	Plot T^2 vs L (1) Where gradient $= \frac{4\pi^2 I}{K}$ (1) [Allow similar argument for T vs $\sqrt{L}$]	**2**
2(b)(ii)	$K = \frac{4\pi^2 I}{\text{gradient}}$ (1) [Calculation of K consistent with gradient in part (i)]	**1**
2(c)	Eliminates effects of reaction time (1) Percentage uncertainty reduced (1) [MP2 dependent on MP1]	**2**
	Total for Question 2	**8**

Question Number	Answer	Mark
3(a)(i)	Line is a smooth curve passing close to all the points (1) Maximum between 101.2 Hz & 101.5 Hz (1)	**2**
3(a)(ii)	Correct reading of maximum from graph (1)	**1**
3(a)(iii)	Correct reading of f_0 from graph (1)	**1**
3(b)	Idea that a more accurate best fit line can be drawn around the peak (1)	**1**
	Total for Question 3	**5**

Question Number	Answer		Mark
4(a)	<u>Systematic</u> (error)	(1)	**1**
4(b)	Distance between sample/protactinium/source and GM tube/detector [Ignore references to background count rate]	(1)	**1**
4(c)	Show ln version of equation: $\ln A = \ln A_0 - \lambda t$ Comparison to $y = mx + c$ **and** clear link between m and (−) λ	(1) (1)	**2**
4(d)	Ln values correct in table to 3/4 s.f. Axes labelled with quantities and units Scales Plots Line of best fit	(1) (1) (1) (1) (1)	**5**
4(e)	Uses two pairs of values from best fit line Uses a large triangle Gradient = -9.20×10^{-3} to -1.10×10^{-2} [ignore unit] λ positive with unit and 3.s.f. <u>Example of calculation</u> gradient $= \frac{3.72-5}{136-0} = -9.41 \times 10^{-3}$ $\lambda = 9.41 \times 10^{-3}\ \text{s}^{-1}$	(1) (1) (1) (1)	**4**
4(f)(i)	Answer consistent with λ in (e) with unit <u>Example of calculation</u> $t_{½} = 0.69 / 9.41 \times 10^{-3} = 73.3$ s	(1)	**1**
4(f)(ii)	Calculates % difference using calculated value of $t_{½}$ Suitable comment consistent with % difference [MP2 dependent on MP1] <u>Example</u> 1.2 minutes is 72 s so % difference is (73.3-72)/72 × 100 = 1.8 % The value is accurate as the % difference is small/less than 5 %	(1) (1)	**2**
	Total for Question 4		**16**

Time/s	Count rate/s^{-1}	Ln(count rate /s^{-1})
0	150	5.01
20	126	4.84
40	98	4.58
60	88	4.48
80	70	4.25
100	61	4.11
120	46	3.83
140	39	3.66
160	28	3.33


ln (count rate/s⁻¹).
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
0
20
40
60
80
100
120
140
160
time/s.
gradient = -1.28/136
= - 9.41×10⁻³ s⁻¹
Δy = 5 - 3.72
= - 1.28
Δx = 136.

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