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Mark Scheme (Results)

October 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.

Physics Specific Marking Guidance

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:
Horizontal force of hinge on table top
66.3 (N) or 66 (N) **and** correct indication of direction [no ue]
[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.

Mark scheme format

• Bold lower case will be used for emphasis.
• Round brackets ( ) indicate words that are not essential e.g. "(hence) distance is increased".
• Square brackets [ ] indicate advice to examiners or examples e.g. [Do not accept gravity] [ecf].

Unit error penalties

• 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.
• Incorrect use of case e.g. 'Watt' or 'w' will not be penalised.
• 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.
• The same missing or incorrect unit will not be penalised more than once within one question but may be penalised again in another question.
• 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.
• The mark scheme will indicate if no unit error penalty is to be applied by means of [no ue].

Significant figures

• 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.
• Use of an inappropriate number of significant figures will normally be penalised in the practical examinations or coursework.
• Using $g = 10\ \text{m s}^{-2}$ **will** be penalised.

Calculations

• Bald (i.e. no working shown) correct answers score full marks unless in a 'show that' question.
• Rounding errors will not be penalised.
• 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.
• 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.
• recall of the correct formula will be awarded when the formula is seen or implied by substitution.
• The mark scheme will show a correctly worked answer for illustration only.

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.

Question Number	Answer		Mark
1(a)(i)	%U = 0.5 % <u>Example of calculation:</u> %U = 0.1 mm / 20 mm × 100 % = 0.5 %	(1)	**1**
1(a)(ii)	Repeat readings and calculate mean To minimise random errors **Or** Measure several different places on tile and calculate mean To allow for variation in thickness/length/width of tile **Or** Check zero error on vernier callipers and/or micrometer To correct systematic error	(1) (1) (1) (1) (1) (1)	**2**
1(b)(i)	Correct calculation of mean volume And correct to 3 sf with corresponding unit (dependent on MP1) <u>Example of calculation:</u> Volume = 23.4 mm × 23.1 mm × 7.95 mm = 4297 mm^3 Volume = 4.30×10^{-6} m^3	(1) (1)	**2**
1(b)(ii)	Calculates half range in each reading (Accept range) Calculates %U in each reading [allow mark if 0.5% as %U in length] Adds the %U (accept answers to 1, 2 or 3 sf) <u>Example of calculation:</u> ½ range for length = 0.2 mm ½ range for width = 0.1 mm ½ range for thickness = 0.02 mm %U for length = 0.2 mm / 23.4 mm × 100 % = 0.85 % %U for width = 0.1 mm / 23.1 mm × 100 % = 0.43 % %U for thickness = 0.02 mm / 7.95 mm × 100 % = 0.25 % Total %U = 0.85 + 0.43 + 0.25 = 1.5 %	(1) (1) (1)	**3**
1(c)(i)	Use of $d = m / V$ Density to 3 sf with corresponding unit (ecf from 1(b)(i)) <u>Example of calculation:</u> Density = mass / volume = 10.03×10^{-3} kg / 4.30×10^{-6} m^{-3} = 2333 kg m^{-3} Density = 2330 kg m^{-3}	(1) (1)	**2**

1(c)(ii)	Calculates upper and/or lower limit of candidate's value of density using calculated %U (1) Comparison made to 2500 kg m^{-3} (dependent on MP1) (1) <u>Example of calculation:</u> Upper limit to measured density = 2330 + (2330 × 1.5 %) = 2360 kg m^{-3} This is lower than given density of 2500 kg m^{-3}so tile probably not made of crown glass **Or** Calculation of % difference between candidate's value and 2500 kg m^{-3}. (1) Comparison of % difference with %U in density (volume) (dependent on MP1) (1) <u>Example of calculation:</u> $\%D = \frac{2500-2330}{2500} \times 100 = 6.8\ \%$ As %D is greater than %U so tile probably not made of crown glass	**2**
	Total for question 1	**12**

Question Number	Answer	Mark
2(a)	Greater number of conduction/free electrons [Accept charge carriers for electrons] (1)	**1**
2(b)(i)	So that p.d. does not affect current **Or** only temperature affects current (1)	**1**
2(b)(ii)	Suitable circuit to include power supply **and** thermistor (1) Means of adjusting p.d. (variable power supply or variable resistor) (1) Ammeter and voltmeter in correct positions (1)	**3**
2(c)(i)	Beaker of water/ice **and** thermometer (1) Ice **and** heater for water (1)	**2**
2(c)(ii)	Remove heater just before taking reading **Or** place thermometer and thermistor close to each other **Or** stir the water (1)	**1**
	Total for question 2	**8**

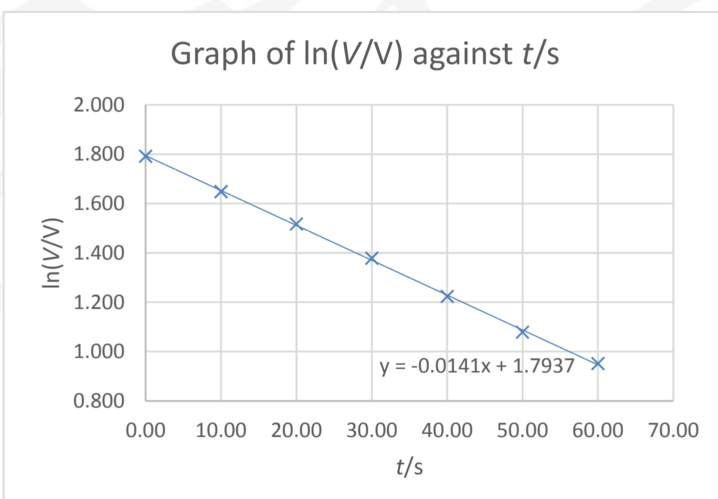
Question Number	Answer		Mark
3(a)	So system is performing SHM	(1)	**1**
3(b)	Measure nT and divide by n (to find T) Use of a (fiducial) marker at the centre of the oscillation **Or** repeat procedure several times and calculate mean	(1) (1)	 **2**
3(c)(i)	Plot T^2 (y-axis) against m (x-axis) As $T^2 = \left(\frac{4\pi^2}{k}\right) m$ is in the form $y = mx$ (+ c) **Or** Plot T (y-axis) against $\sqrt{m}$ (x-axis) As $T = \left(\frac{2\pi}{\sqrt{k}}\right) \sqrt{m}$ is in the form $y = mx$ (+ c) **Or** Plot log T against log m As log T = ½ log m + log ($2\pi/\sqrt{k}$) is in the form $y = mx + c$	(1) (1) (1) (1) (1) (1)	 **2**
3(c)(ii)	Measure T for rock, calculate T^2 and read value of m from graph **Or** Measure T for rock, read value of $\sqrt{m}$ from graph and calculate m **Or** Measure T for rock, calculate log T, read off from graph and calculate m (Answer to be consistent with graph drawn in (c)(i))	 (1)	 **1**
3(d)	Eliminates reaction time **Or** reading of time at an exact position	 (1)	 **1**
	Total for question 3		**7**

Question Number	Answer	Mark
4(a)	Use the same initial p.d **Or** charge capacitor fully **Or** check for zero error on voltmeter. (1) Place voltmeter close to stopwatch so both can be read at same time **Or** make use of lap timer facility on stopwatch **Or** use datalogger so V and t measured simultaneously (1)	**2**
4(b)	See $\ln(V) = \ln(V_0) - t/RC$ as $y = c + mx$ (1) where the gradient $m = -1/RC$ which is constant (1)	**2**

Question Number	Answer	Mark
4(c)(i)	ln(*V*/V) values correctly calculated to 3 or 4 sf (1) Suitable scales; greater than half grid used in **both** directions (1) Axes labelled: y- axis as ln(*V*/V) and *x*-axis as *t*/s (1) Points plotted accurately (2) Best fit line drawn (1)	**6**

t/s	Mean *V*/V	ln (*V*/V)
0.00	6.00	1.792
10.00	5.20	1.649
20.00	4.56	1.517
30.00	3.97	1.379
40.00	3.40	1.224
50.00	2.94	1.078
60.00	2.59	0.952

Question Number	Answer	Mark
4(c)(ii)	Gradient of graph correctly calculated from large triangle (at least half of the drawn line) (1) Use of gradient of graph = (–)1/*RC* (1) Calculation of *C* to 3 sf with unit (1) <u>Example of calculation:</u> Gradient = (0.80 – 1.79) / 70.0 = – 0.0141 *RC* = – 1 / – 0.0141 = 70.9 (s) $C = 70.9\text{ s} / 68 \times 10^3\ \Omega = 1.04 \times 10^{-3}$ F	**3**



	Total for question 4	**13**

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