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Mark Scheme (Results)

June 2011

GCE Physics (6PH08) Paper 01
Experimental Physics (WA)

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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 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.

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>1(a)</td><td>

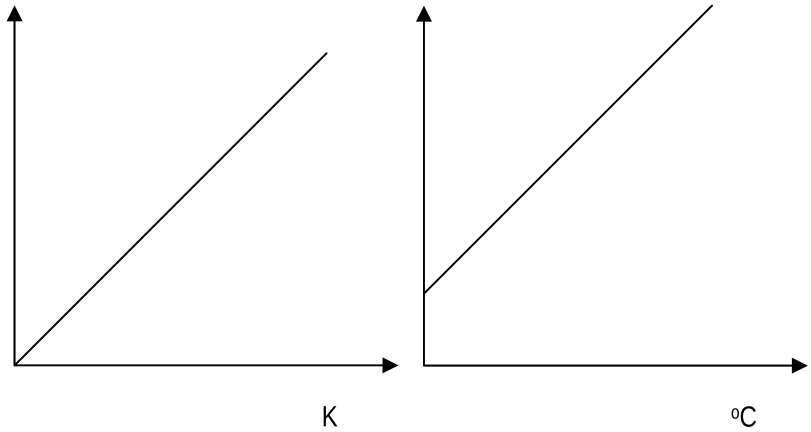
Measurement	Instrument
Width	**(Vernier) callipers**
Thickness	**Micrometer (screw gauge)** accept **<u>digital</u> (vernier) callipers**

Both correct (1)
Reason:
To obtain both measurements to 3 SF (1)
</td><td>2</td></tr>
<tr><td>1(b)</td><td>
Mean values for both width and thickness seen (1)
Correct substitution into density equation (1)
Correct value of density to 3 or 4 SF and unit (1)
<u>Example of calculation</u>
Volume = 1.00 x 28.9 x 10^{-3} x 5.99 x 10^{-3} = 1.73 x 10^{-4} m^{-3}

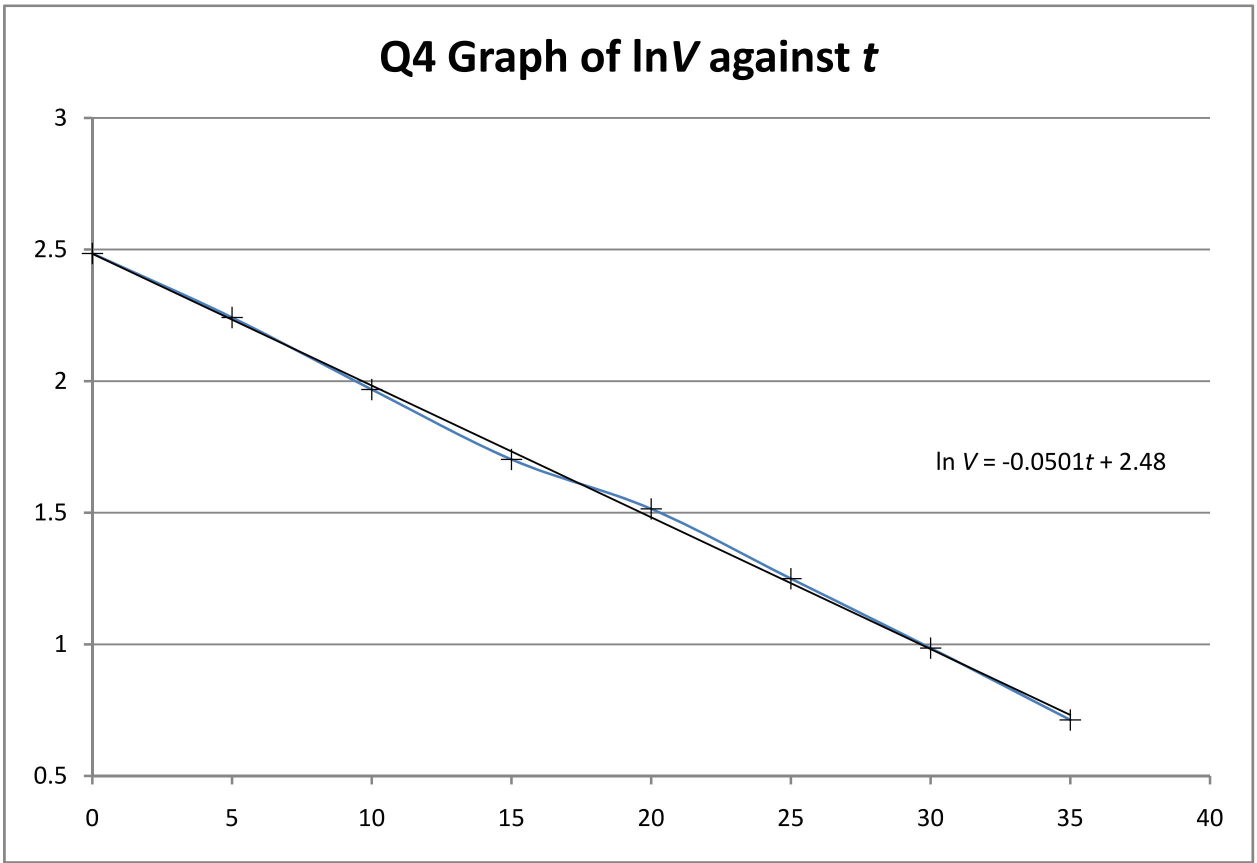
Density = 0.1064/1.73 x 10^{-4} = 615 kg m^{-3} (Accept 0.615 g cm^{-3} and 6.15 x 10^{-4} g mm^{-3})
</td><td>3</td></tr>
<tr><td>1(c)</td><td>
Uncertainty in t or w correct (1)
Both % uncertainties calculated correctly (allow ecf) (1)
% U added to combine (1)
Eg Width ± 0.55 mm (accept ± 1.1 mm), %U = 0.55/28.9 = 1.9%
Thickness ± 0.05 mm (accept ± 0.1 mm), %U = 0.05/5.99 = 0.83%
% uncertainties added - expect 2.7% or 5.4%
</td><td>3</td></tr>
<tr><td></td><td>Total for question 1</td><td>8</td></tr>
</table>

Question Number	Answer	Mark
2	Sensible comment on safety e.g. Keep hands away from the source **(1)** Any **FIVE** from Measure (and record) background (count rate) **(1)** Mark *d* on diagram **(1)** Source and counter in line **(1)** Use metre rule to measure *d* (may be from diagram) **(1)** Measure to the same points (on the tube and source) each time **(1)** Start with tube close to source (and increase *d)* **(1)** Zero counter and start clock **(1)** Measure count for the same time each time **(1)** Repeat readings and find mean **(1)** For 5 mm < *d* < 35 mm **(1)** Plot graph of count against *d* **(1)** Where count (rate) falls sharply/to background is distance travelled in air **(1)**	**1** **Max 5**
	Total for question 2	**6**

Question Number	Answer	Mark
3(a)(i)	Diagram to show water/oil bath surrounding flask **(1)** Means of heating apparatus, labelled **(1)**	**2**
3(a)(ii)	Ice to get to 0 ^{o}C **and** method to reach 100 ^{0}C **(1)**	**1**
3(a)(iii)	Temperature sensor/thermometer submerged in the water/oil bath (may be from diagram) **(1)**	**1**
3(a)(iv)	Any **TWO** from Flask full immersed in the water/oil bath **(1)** Remove heat source whilst taking reading or adjust thermostat on water bath **(1)** Allow (time for) apparatus to come to thermal equilibrium **(1)** Temperature sensor close to flask or temperature sensor not touching sides or bottom **(1)**	**Max 2**

3(b)	Straight line graph **(1)** Temperature axis labelled ˚C, K or absolute temperature **(1)** Graph consistent with temperature scale **(1)** 	**3**
	Total for question 3	**9**

Question Number	Answer		Mark
4(a)(i)	Answer = 22 s <u>Example of calculation</u> $T = 220 \times 10^3\ \Omega \times 100 \times 10^{-6}$ F	**(1)**	**1**
4(a)(ii)	Time taken for the p.d/charge/current to change by 63% *or* to fall to 1/e of its original value *or* to fall to (12/e)V *or* to fall to 4.41 V	**(1)**	**1**
4(b)(i)	To reduce/prevent charge/current through the voltmeter.	**(1)**	**1**
4(b)(ii)	Precision of stopwatch much less than reaction time *or* uncertainty significantly less than 22 s.	**(1)**	**1**
4(b)(iii)	Repeat experiment and calculate mean value *or* use graphical method	**(1)**	
4(c)	Correct expansion $\ln V = -t/RC + \ln V_0$ Compare with $y = mx + c$ *or* state that *RC* is constant	**(1)** **(1)**	**2**
4(d)	ln values correct and to at least 2DP Labels axes with quantity and unit; y-axis must be labelled ln (V/V) Scales, (expect 1cm:0.1 vertically) Points correctly plotted and best straight line	**(1)** **(1)** **(1)** **(1)**	**4**
4(e)(i)	Large triangle (at least half the drawn line) with correct values Correct calculation for *T* in range $19.8 < T < 20.2$ and at least 3 SF (no unit penalty)	**(1)** **(1)**	**2**
4(e)(ii)	Uses 22 s and graph value to calculate % difference correctly <u>Example of calculation</u> (20.0 – 22.0)/22 = 2.0/22 = 9.1%	**(1)**	**1**
4(f)(i)	ln 5 (=1.609) used to find time from graph Value in range 17.4 s – 17.6 s and to 3 SF	**(1)** **(1)**	**2**
4(f)(ii)	Answer = 150 kΩ (option C) <u>Example of calculation</u> 220 x (12/17.5) = 150	**(1)**	**1**
	Total for question 4		**17**



t/s	*V*/V	ln(V/V)
0	12.00	2.48
5	9.41	2.24
10	7.16	1.97
15	5.49	1.70
20	4.55	1.52
25	3.49	1.25
30	2.68	0.99
35	2.04	0.71

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