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Mark Scheme (Results)

Summer 2012

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.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. Questions labelled with an **asterix (*)** are ones where the quality of your written communication will be assessed.

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:

- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.

( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.

Phrases/words in **bold** indicate that the <u>meaning</u> of the phrase or the actual word is **essential** to the answer.

ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

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.

For example:

(iii) 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.]	✓	**1**

This has a clear statement of the principle for 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 ms has specified specific words that must be present. Such words will be indicated by underlining e.g. 'resonance'

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

2.3 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, for example in a spreadsheet.

2.4 The same missing or incorrect unit will not be penalised more than once within one question (one clip in epen).

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

3.1 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.

3.2 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 be penalised by one mark (but not more than once per clip). Accept 9.8 m s^{-2} or 9.8 N kg^{-1}

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.

4.6 Example of mark scheme for a calculation:

'Show that' calculation of weight

Use of L × W × H	✓	
Substitution into density equation with a volume and density	✓	
Correct answer [49.4 (N)] to at least 3 sig fig. [No ue] [If 5040 g rounded to 5000 g or 5 kg, do not give 3rd mark; if conversion to kg is omitted and then answer fudged, do not give 3rd mark] [Bald answer scores 0, reverse calculation 2/3]	✓	**3**

Example of answer:

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. Graphs

5.1 A mark given for axes requires both axes to be labelled with quantities and units, and drawn the correct way round.

5.2 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.

5.3 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, 7 etc.

5.4 Points should be plotted to within 1 mm.

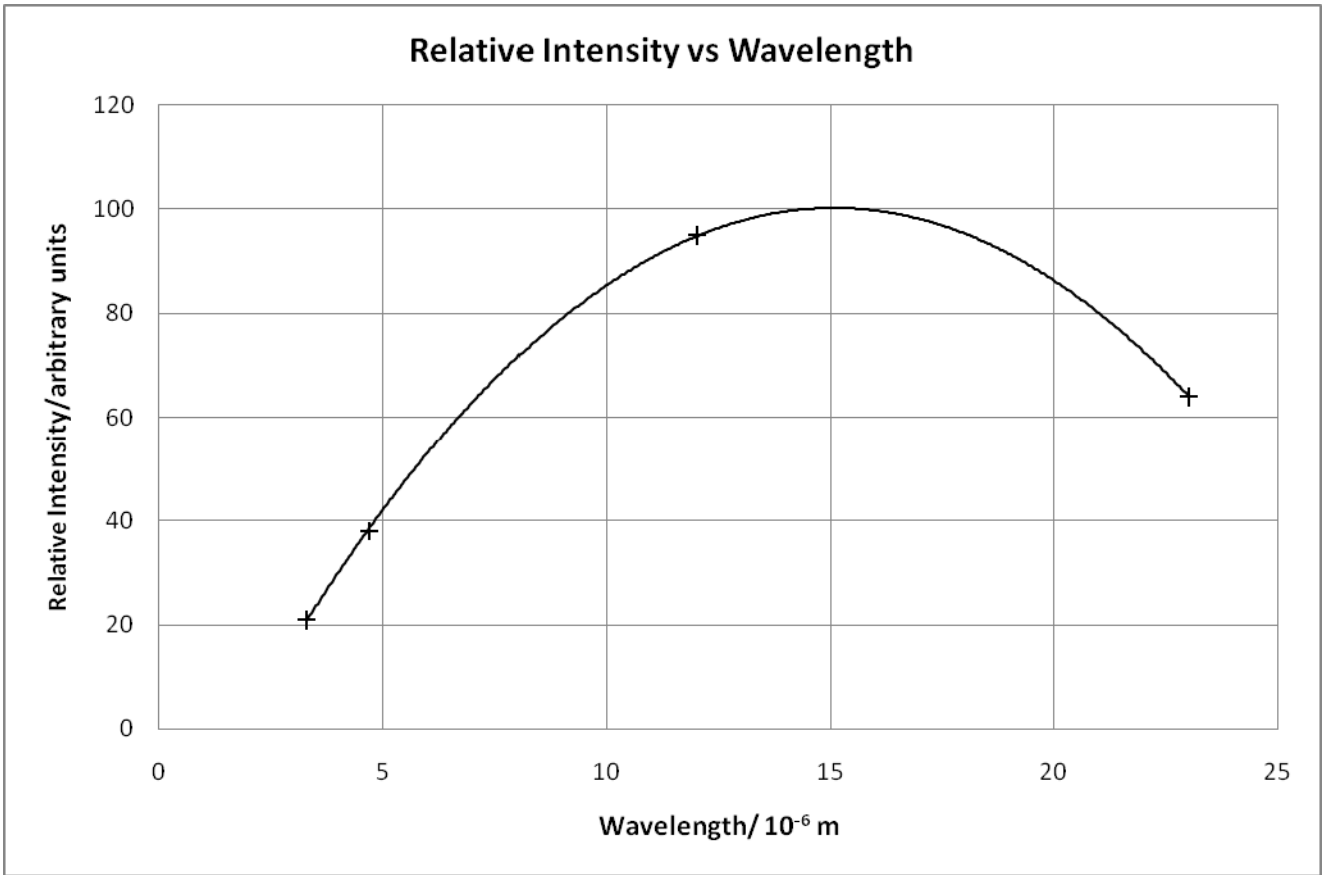
- Check the two points furthest from the best line. If both OK award mark.
- If either is 2 mm out do not award mark.
- If both are 1 mm out do not award mark.
- If either is 1 mm out then check another two and award mark if both of these OK, otherwise no mark.

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)	Use a metre rule in a number of places or other valid comment	**(1)**	**1**
1(a)(ii)	(100 × 1/20 =) 5%	**(1)**	**1**
1(b)	Measure the time for more than one cross at a time (not one cross a number of times) Repeat and find mean	**(1)** **(1)**	**2**
1(c)(i)	(0.334/0.92 =) 0.36(3) ms^{-1} to 2 or 3SF with unit	**(1)**	**1**
1(c)(ii)	Calculates %U for distance or time correctly adds **both** correct %U - no SF penalty Example of calculation 100 × (2/334 + 3/92) = 0.6 + 3.3 = 3.9%, accept 3.86% and 4%	**(1)** **(1)**	**2**
1(d)(i)	Correct calculation for speed squared divided by 0.021 m – 2/3 SF but ignore unit Example of calculation $(0.363)^2$ / 0.021 = 6.27 ms^{-2} (allow 6.17 or 6.2 if 0.36 used)	**(1)**	**1**
1(d)(ii)	Doubles %U in *v* (c(ii)) and adds to %U in *d* (a(ii)) Example of calculation (3.9 × 2) + 5 = 12.8% allow ecf on their values	**(1)**	**1**
1(e)	Calculates % Difference, must use 9.81 as denominator eg %D is 100 × ((9.81 – 6.27)/9.81) = 36% **Or** uses uncertainty to calculate likely maximum value for *k* eg (1 + 0.128) x 6.3 = 7.11 ms^{-2} Makes valid comment based on comparison of data eg %D > %U so $k \neq g$ *or* 7.11 < 9.81 so $k \neq g$	**(1)** **(1)**	**2**
	Total for question 1		**11**

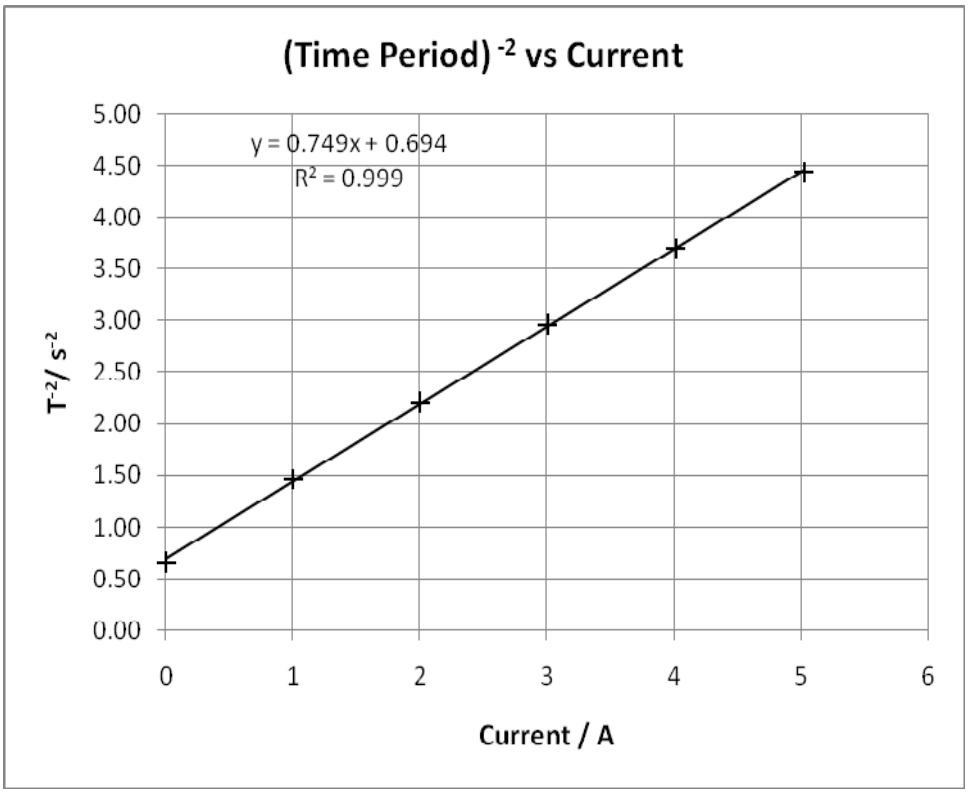
Question Number	Answer		Mark
2(a)	**Max 2** To limit the current to prevent the diode overheating / getting damaged when variable resistance is reduced to zero	**(1)** **(1)** **(1)**	**2**
2(b)	Labelled diagram showing a suitable arrangement of thermometer and diode with indirect heating method [do not allow arrow labelled heat]. Water, shown by either meniscus or label, beaker need not be labelled Safety: Either thermometer or the beaker is supported	**(1)** **(1)**	**2**
2(c)(i)	**Max 1** Ensures the temperature measured is the temperature of the diode **Or** So the temperature remains steady (during reading) **Or** Thermal equilibrium between <u>diode and water</u>	**(1)** **(1)** **(1)**	**1**
2(c)(ii)	**Max 2** Stir water Thermometer close to diode Check voltmeter reading before *and* after reading current Keep thermometer/diode away from walls/base of beaker [Not diode completely immersed]	**(1)** **(1)** **(1)** **(1)**	**2**
2(d)	Diode resistance reduces/number of charge carriers increases (with temperature)	**(1)**	**1**
	Total for question 2		**8**

Question Number	Answer		Mark
3(a)(i)	Well drawn best fit line, ignore origin With maximum greater than or equal to 14 – by eye [Award zero for straight line]	**(1)** **(1)**	**2**
3(a)(ii)	λ_{max} found correctly with unit [ecf their graph, even if straight] eg 15 x 10^{-6} m	**(1)**	**1**
3(b)	T = 2.898 x 10^{-3} / Their λ_{max} Use their λ_{max} in correct calculation of T with Kelvin as unit eg T = 190 K 2, 3 or 4 SF	**(1)** **(1)**	**2**
3(c)	**Max 2** Only one observation at each value / No repeats Only four data points Graph not a straight line No reading at maximum/ Value for λ_{max} very uncertain Radiation intensity faint so difficult to measure accurately Allow other good physics in appropriate context eg Doppler [Ignore inconsequential points, such as anomalies, unless con]	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**2**
	Total for question 3		**7**



Question Number	Answer		Mark
4(a)	Wood is not magnetisable/ferromagnetic allow 'attracted' reject 'metal'	**(1)**	**1**
4(b)	**Max 3** Measure more than one T Repeat for mean Use of marker, must state where placed or that it helps in counting or timing Allow one other good physics technique in appropriate context	**(1)** **(1)** **(1)** **(1)**	**3**
4(c)	Oscillations die away more quickly. [Allow ref to amplitude but not speed. Allow a heavily damped response]	**(1)**	**1**
4(d)(i)	Links both axes with variables and y = mx (+c) **Or** Links k with gradient States that variables are directly proportional **or** states that c = 0	 **(1)** **(1)**	**2**
4(d)(ii)	Data correct to 2/3DP with unit Axes & labels Scales Plots Line [See paragraph 5 at top of mark scheme]	**(1)** **(1)** **(1)** **(1)** **(1)**	**5**
4(d)(iii)	**Max 2** Graph is a straight line Graph does not pass through origin **or** c = b ≠ 0 magnet oscillates at zero current **or** one other good physics comment in appropriate context	 **(1)** **(1)** **(1)**	**2**
	Total for question 4		**14**

***I* / A**	**Mean *T* /s**	**$1/T^2/s^{-2}$**
0	1.23	0.66
1.00	0.827	1.46
2.00	0.673	2.21
3.00	0.581	2.96
4.02	0.520	3.70
5.01	0.475	4.43



TOTAL MARKS FOR THIS PAPER = 40

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