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# Mark Scheme (Results)

## Summer 2015

## 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.

### Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

**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]<br>[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]<br>[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]<br>[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. 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 a max mark, the final mark not being awarded unless the QoWC condition has been satisfied.

## 6. Graphs

6.1 A mark given 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, 7 etc.

6.4 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)** | 1 mm ± 1 mm millimetre<br>(Do not accept 0.5 mm) | **(1)** | **1** |
| **1(a)(ii)** | Correct method is the can on its side with two vertical set squares touching the can and touching the rule. Diagrams can be front elevation or plan view. (Check text for contradiction)<br>Any correct diagram that will work scores 2 marks.<br>Award 1 mark for correct use of two set squares. | **(1)**<br>**(1)** | **2** |
| **1(b)(i)** | Volume = 411 $cm^3$ (to at least 2 sf)<br><br>Example of calculation<br>$V = \pi \times (7.2/2\ cm)^2 \times 10.1\ cm = 411\ cm^3$ | **(1)** | **1** |
| **1(b)(ii)** | Volume = 15 $cm^3$ ('show that' value gives 4 $cm^3$)<br>ecf their value for volume in (i)<br><br>Example of calculation<br>411 $cm^3$ – 396 $cm^3$ = 15 $cm^3$ | **(1)** | **1** |
| **1(b)(iii)** | Density of metal = 3.3 g $cm^{-3}$ or 3300 $kgm^{-3}$ ecf their value from (ii)<br>with 2 SF and unit<br><br>Example of calculation<br>Density = 49.82 g / 15 $cm^3$ = 3.3 g $cm^{-3}$ | **(1)**<br>**(1)** | **2** |
| **1(c)(i)** | Use of half range or range to give<br>%U in diameter = 1.4% or 2.8%<br>%U in external volume = 2.8% or 5.6%<br><br>Example of calculation<br>(1/72)×100 = 1.4% for *d* hence 2.8% for volume | <br>**(1)**<br>**(1)** | **2** |
| **1(c)(ii)** | Use of half range or range to give<br>%U = 1% or 2%<br><br>Example of calculation<br>(0.5×(399 cm – 391 cm)//396 cm) × 100% = 1% | **(1)** | **1** |
| **1(c)(iii)** | Method involves subtracting two values close together leading to a small value of volume (leading to large % uncertainty) | **(1)** | **1** |
| | **Total for Question 1** | | **11** |

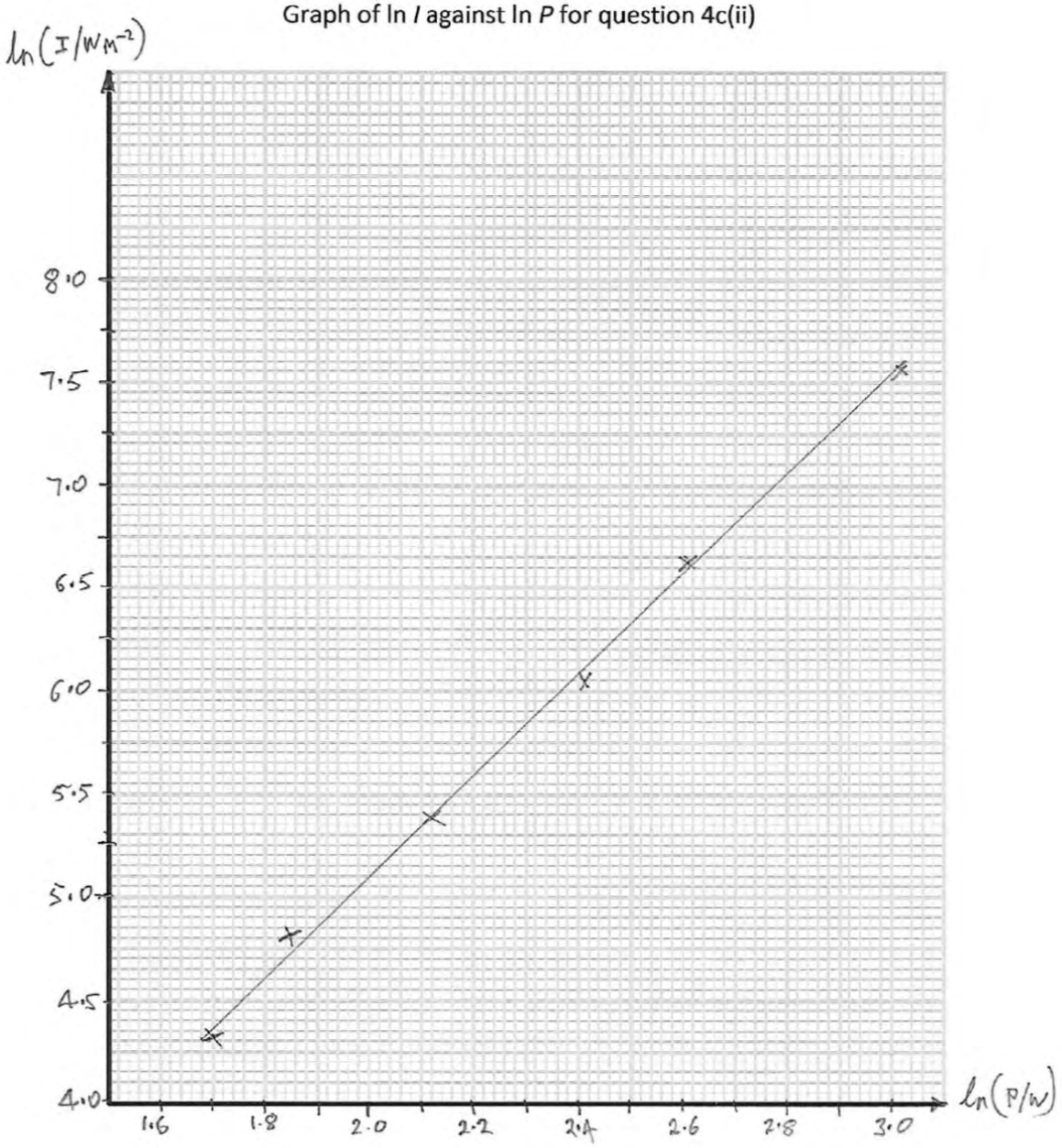
| Question Number | Answer | | Mark |
|---|---|---|---|
| **2(a)(i)** | **Max 2**<br>Record $nT$ **and** divide (time measurement) by $n$<br>Use timing marker at midpoint of oscillation/equilibrium<br>Repeat **and** find mean | **(1)**<br>**(1)**<br>**(1)** | **2** |
| **2(a)(ii)** | Plot a graph of $T^2$ against $m$<br>Comparison with y = mx (+ c)<br>$k = 4\pi^2$/gradient<br><br>allow for 1st and 3rd marking points<br><br>$T$ vs $\sqrt{m}$ \| $k = 4\pi^2$/ (gradient)$^2$<br>ln $T$ vs ln $m$ \| exp(intercept) = $2\pi/\sqrt{k}$<br>so $k = 4\pi^2$/ exp(2×intercept) | **(1)**<br>**(1)**<br>**(1)** | **3** |
| **2(b)(i)** | A diagram showing spring with masses and sensor vertically below<br>Sensor connected to datalogger (dependent mark) | **(1)**<br>**(1)** | **2** |
| **2(b)(ii)** | **Max 2**<br>Readings displayed graphically<br>Eliminates effect of reaction time<br>Precision of $T$ to more than 0.01 s **Or** comparison to stopwatch | **(1)**<br>**(1)**<br>**(1)** | **2** |
| | **Total for question 2** | | **9** |

| Question Number | Answer | | Mark |
|---|---|---|---|
| **3(a)** | Any **one** from<br>No repeats<br>only four values<br>no estimate of uncertainty | **(1)** | **1** |
| **3(b)(i)** | Good straight line – must not go through both top and bottom points | **(1)** | **1** |
| **3(b)(ii)** | Big triangle – at least half the plotted length<br>Valid gradient calculation<br>multiplies their gradient by $e$<br>$h = (7.68 – 8.16) \times 10^{-34}$ Js to 3sf and unit<br><br><u>Example of calculation</u><br><br>$0.495 \times 10^{-14} \times 1.6 \times 10^{-19} = 7.92 \times 10^{-34}$ Js | **(1)**<br>**(1)**<br>**(1)**<br>**(1)** | **4** |
| **3(b)(iii)** | Correct calculation of %D<br>ecf their value in (ii)<br><br><u>Example of calculation</u><br>$(7.92 – 6.63)/6.63 \times 100\% = 19\%$ | **(1)** | **1** |
| | **Total for question 3** | | **7** |

| Question Number | Answer | | Mark |
|---|---|---|---|
| **4(a)** | Circuit including power supply, bulb, with voltmeter and ammeter shown correctly connected<br><br>Includes means of varying power – variable psu or variable resistor | **(1)**<br><br>**(1)** | **2** |
| **4(b)(i)** | (Resistance) decreases | **(1)** | **1** |
| **4(b)(ii)** | Intensity varies/decreases with distance<br>**Or** the intensity only depends on the power display | **(1)** | **1** |
| **4(c)(i)** | $\ln I = x \ln P + \ln k$<br>Compares with y = mx + c **and** states that gradient/m is constant | **(1)**<br>**(1)** | **2** |
| **4(c)(ii)** | **Graph**:<br>ln values correct and consistently to 3 or 4 SF<br>Axes correct & labelled<br>Scales<br>Plots<br>Line of Best Fit | <br>**(1)**<br>**(1)**<br>**(1)**<br>**(1)**<br>**(1)** | **5** |
| **4(c)(iii)** | Big triangle – at least half the plotted length<br>x within range 2.38 – 2.48 **and** with no unit | **(1)**<br>**(1)** | **2** |
| | **Total for Question 4** | | **13** |

| ***P*/W** | ***I*/Wm$^{-2}$** | **ln(*P*/W)** | **Ln (*I*/Wm$^{÷2}$)** |
|---|---|---|---|
| 20.47 | 1900 | 3.02 | 7.55 |
| 13.09 | 740 | 2.57 | 6.61 |
| 11.09 | 425 | 2.41 | 6.05 |
| 8.29 | 220 | 2.12 | 5.39 |
| 6.37 | 123 | 1.85 | 4.81 |
| 5.45 | 76 | 1.70 | 4.33 |

Graph of ln *I* against ln *P* for question 4c(ii)



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