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Physics PHA6/B6/T

Unit 6: Investigative and practical skills in A2 Physics

Report on the Examination

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GCE Physics, PHA6/B6/T, Practical and Investigative Skills in A2 Physics

General Comments

Reports from moderators confirmed that ISA P (Cooling water) and ISA Q (SHM) were equally popular in the scripts sampled, suggesting an equivalence in standard of both ISA's.

After some initial problems in sourcing appropriate glass tubing for the U-tube SHM experiment, feedback from centres suggested the experiments worked well, enabling students to take the data required with no significant problems in conducting the experiments.

Administrative Issues

Most centres dealt with administrative issues efficiently, ensuring that scripts, Centre Mark Sheets, Centre Declaration Forms and Student Record Forms were delivered to moderators by the prescribed deadline.
There were, however, issues with a small number of centres, where scripts arrived late or with missing documentation.

As in previous years there were still a small but significant number of centres where arithmetic and transcription errors were discovered on scripts sampled. It is the centre's responsibility to ensure correct addition of PSA marks to the marks for each section of the ISA test. Although some errors are discovered and corrected by moderators only a proportion of scripts are checked and remarked in the moderation process, with the possibility of other errors left undiscovered.

Centre Marking

The standard of marking was very good in most cases, with markers carefully following the mark scheme.
There were, however, a significant number of centres where marking was outside the tolerance of $\pm$ 3, and in these cases an adjustment to centre marks will usually be made. In all of these cases the marking was too lenient, rather than too severe.
The most common marking errors were condoning:

- Unsuitable graph scales
- Incorrectly plotted graph points
- Inappropriate lines of best fit
- Missing units in questions where mark scheme specifically stated that the correct unit was required.
- 'Weak' explanations, not fulfilling the requirements specified in mark scheme

ISA P

Stage 1

Feedback from centres suggested the experiment worked well with few problems. Students of all abilities were able to score well on this section with most achieving 6 or 7 marks. The most common mistakes were:

- Graph scales
- Incorrectly plotted points
- 'Joining points' rather than drawing the best smooth curve .

Allowance was made for 10p coin thickness where centres had used a proportion of the older, slightly thinner coins.

Section A

Question 1

Part 1(a) discriminated well and many weaker students failed to score any of the 2 marks. The unit was required together with the numerical answer for the second mark.

In part 1(b)(i) for the 1 mark students had to explain briefly what to do – i.e. draw a tangent to the curve at t=300s and find its gradient. A small proportion of students thought they had to actually do the calculation!

In part 1(b)(ii) most students correctly ticked the second box.

In part 1(c) only the weakest students failed to calculate volume of the coins, although a few more lost credit by failing to quote the unit or using too many significant figures.

Part 1(d) discriminated well. Marks were usually lost by forgetting to double the % uncertainty in the *r* or *d* and quoting too many significant figures in the final answer.

In part 1(e) weaker students struggled and many students gave an incorrect unit or failed to quote a unit.

In part 1(f) only the more able students were able to score 3 or 4 marks on this question. Many students failed to realise that the uncertainty in the temperature difference was double the uncertainty in an individual temperature reading (taken from the thermometer precision). This also needs to be converted to a percentage to compare to the percentage uncertainty in the ruler measurements.

Section B

Question 2

Part 2(a) was answered well by a large proportion of students.

Part 2(b) was correctly done by almost all students, quoting correct values with the correct number of significant figures consistent with other values in the table.

In part 2(c) although a straightforward question which most students can do, careless plotting and some poor lines of best fit were still evident.

Part 2(d) discriminated well with only the more able students achieving both marks. The interpretation of a log-log graphs is a common question in A2 ISA's.

In part 2(e) the most common mistake was to miss out the minus sign from the gradient value.

In part 2(f) only the weaker students failed to realise that *k* was numerical equal to the gradient with the opposite sign. Some marks were lost by omission of the unit.

Part 2(g) proved more demanding than anticipated and discriminated well at the lower grades. Omission of units and inappropriate significant figures accounted for a proportion of the marks lost.

In part 2(h) key points were to use a much longer cooling period and a larger initial temperature difference.

Question 3

As usual this type of question discriminated well. More able students did realise that a comparison should be made with and without the cover. It was still possible to score 3 marks from marking points (b), (d) and (e) without this comparison.

ISA Q

Stage 1

The experiment worked well, although due to damping it was more difficult to measure the time period than in previous SHM ISA's. As in ISA P, marks of 6 or 7 were achieved by a large proportion of students.
The most common mistakes were:

- Fewer than 3 readings of internal diameter of the tube
- Inappropriate graph axes
- Misplotted points
- Poor lines of best fit

Section A

Question 1

In part 1(a) many students failed to realise that where a non zero scale was used on the graph it is impossible to say if the line goes through the origin. Consequently in this situation it is incorrect to say with certainty that the relationship is (directly) proportional. Students would be expected to deduce there is definitely a linear relationship but proportionality can only be concluded if it is known for definite if the line goes through the origin.

In part 1(b) rearrangement of the formula was straightforward but many students failed to relate this rearrangement to the gradient of the graph.

Parts 1(c)(i) & (ii) were straightforward uncertainty calculations requiring use of uncertainty = 0.5 X range. Where there is no spread of repeat readings the instrument precision should be used.

Part (iii) was more demanding and discriminated well. It required students to convert uncertainties to percentages for comparison and then to double the uncertainties in T and d to determine the uncertainties in T^2 and l respectively.

Part 1(d)(i) was relatively easy with most students realising the fairly rapid decrease in amplitude indicated significant damping. The explanation in part (ii) was slightly more demanding and responses involving friction frequently failed to specify exactly 'what the friction was between'.

In part 1(e)(i) most students realised that damping would increase although, despite allowing a range of non scientific terms as detailed in the mark scheme, fewer students were able to give a satisfactory explanation.

Part 1(e)(ii) proved slightly more demanding, with only the better students able to state the effect and give a suitable explanation.

Section B

Question 2

Part 2(a) was answered well by all but the weakest students. The increase in volume means an increased length which gives an increase in the time period.

Part 2(b) was answered correctly by virtually all students, despite concerns from some centres that the units were misleading.

In part 2(c) again the graph points were usually correctly plotted but a proportion of students were unable to draw a satisfactory line of best fit.

In part 2(d) most students drew an appropriate triangle (or used data points sufficiently far apart), and were able to correctly read off and process the data values. The gradient value must have a negative sign, be within the specified limits and quoted to 2 or 3 sf.

Part 2(e) discriminated well with only the more able students scoring more than 3 marks. Understanding of the relationships derived from log-log graphs is a common question, appearing in many A2 ISAs. Students who omitted the minus sign in part (i) could be awarded credit in subsequent parts as 'error carried forward'. Numerical questions in parts (ii) and (iii) were generally done well by students who had successfully answered part (i). The unit in part (iii) proved more difficult.

Question 3

Again this type of question discriminated well with only the more able students scoring 3 or 4 marks. Weaker students were able to score 1 or 2 marks, usually by reference to constant temperature and constant length of water column.

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