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Physics PHA3/B3/T

Unit 3: Investigative and practical skills in AS Physics

Report on the Examination

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GCE Physics, PHA3/B3/T, Practical and Investigative Skills in AS Physics

General Comments

Reports from moderators confirmed that ISA P (the bouncing ball experiment) and ISA Q (the resistance wire experiment) were equally popular in the scripts sampled, suggesting an equivalence in standard of both ISAs. Feedback from centres suggested the experiments worked well, enabling candidates to take the data required with no significant problems with their apparatus.

Administrative Issues

Most centres dealt with administrative issues efficiently, ensuring that scripts, *Centre Mark Sheets*, *Centre Declaration Sheets* and *Candidate Record Forms* (although *Candidate Record Forms* are no longer necessary if the front of the ISA has been fully completed and signed) were delivered to moderators by the deadline. However, there were issues with some centres, where scripts arrived late or were missing documentation.

There were also a small but significant number of centres where arithmetic and transcription errors were discovered on scripts sampled. It is the responsibility of the centre to ensure correct addition of the PSA marks. Although some errors are discovered and corrected by moderators, only a proportion of scripts are checked and remarked in the moderation process, leaving 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. However, there were a significant number of centres where marking was outside the tolerance, and in these cases an adjustment to centre marks will usually be made.

The most common marking errors were; condoning distance measurements quoted to nearest cm rather than mm, 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 and poor explanations, not fulfilling the requirements specified in mark scheme.

ISA P

Stage 1

Almost all candidates were able to follow the instructions and successfully complete the experiment. The most common errors included, taking an appropriate number of measurements in the required range (due to time constraints, a minimum of six readings was allowed rather than the usual requirement for a minimum of seven readings), values of h quoted to nearest cm rather than nearest mm, graph scales which were too small – occupying less than half of each axis, inappropriate lines of best fit, usually with an uneven distribution of points on either side of the line and incorrectly plotted points.

Section A

Question 1

In part (a), B was the correct answer where candidates result produced a straight line graph which did not go through the origin. A or D were also acceptable as ecf where these statements matched the candidates' graph.

Part (b)(i) was a straightforward measurement using a metre ruler and the uncertainty is ± 1 mm. The unit was required for the mark, and this was omitted by a significant number of candidates.

Part (b)(ii) was a straightforward calculation of uncertainty based on 0.5 × range. The unit was again required.

Part (b)(iii) was a more demanding question, requiring an understanding of parallax error in using a metre ruler to measure across the diameter of a ball. A figure greater than 1 mm was required (2 – 5 mm allowed). An explanation of parallax error was required for the second mark (alternative explanations were also allowed as detailed in the mark scheme).

There was a simple calculation in part (c)(i), which was answered well by most candidates. The most common error was to omit the unit, which was again specifically required in this question.

Part (c)(ii) required addition of the individual uncertainties in *h* and *d*. Some candidates subtracted uncertainties incorrectly, presumably because of the subtraction of the terms in the formula quoted in (c)(i).

The correct unit, J, was required in part (c)(iii), this was answered well by most candidates.

Part (c)(iv) was a more demanding question requiring calculation of uncertainties as percentages, which could then be added together to find the overall percentage uncertainty. An answer to one or two significant figures was required.

Section B

Question 2

Part (a) was a straightforward question answered well by most candidates. Since this was a 'show that' question, the correct numerical data must be clearly shown substituted into the formula.

Completion of the table proved to be an easy task for most candidates in part (b).

Most candidates were able to plot the three points correctly in part (c), but a significant proportion of candidates were unable to draw an appropriate line. The initial section of the graph was clearly a straight line, and should have been drawn with a ruler, followed by a careful freehand curve drawn for the final section. Some candidates tried to drawn a single straight line through all the points.

Although determination of the gradient is a standard question on all ISAs, many candidates still fail to achieve the full three marks for part (d)(i). The most common error is misreading of one of the data points, and this then usually gives a gradient value out of tolerance, hence losing another mark. Some candidates still draw triangles (or use equivalent data points) with sides less than the minimum 8 cm required.

Most candidates were able to give the correct unit in part (d)(ii).

For most candidates, who achieved an answer in the allowed range of 3.2 – 3.6 mm, part (e)(i) proved straightforward.

Part (e)(ii) was a more demanding question requiring computation of 70% of the energy followed by use of the graph. There was also a requirement to quote the final answer to two or three significant figures only.

Most candidates correctly answered the straightforward percentage uncertainty calculation in part (f)(i). Only one or two significant figures were allowed. Some candidates seemed unaware that uncertainty calculations are usually only an estimate and that quoting to more than one or two significant figures is inappropriate.

Part (f)(ii) was more demanding, requiring another percentage uncertainty calculation followed by comparison and comment with the value achieved in (f)(i).

Question 3

This question discriminated well, with only higher grade candidates achieving three or more marks. Many candidates gave statements which are too vague to achieve the marking points stated in the mark scheme, for example, stating that the procedure should be repeated for a range of different temperatures does not achieve a mark. The candidate must specify the number of readings to achieve the mark – seven is usually taken as the minimum number of readings in this specification. The mark scheme gave details of the requirements for each mark.

ISA Q

Stage 1

Almost all candidates were able to follow the instructions and successfully complete the experiment. Only a very small proportion of candidates required help in setting up the circuit with the consequent loss of one mark for marking point (a).

The most common errors included; lengths quoted to nearest cm rather than nearest mm, graph scales which were too small – occupying less than half of each axis, inappropriate lines of best fit, usually with an uneven distribution of points on either side of the line and incorrectly plotted points.

Section A

Question 1

Reference to the straight line and the fact that it passed through the origin was required for both marks to part (a).

For part (b), many candidates did not recognise that a stretched metal wire will have some evidence of 'kinks' and is not a 'perfect' straight line. Consequently, it is unrealistic to expect the uncertainty to be as small as ± 1 mm. Values of ± 2 – 5 mm were accepted as a reasonable approximation of the uncertainty.

Parts (c)(i) & (ii) were straightforward percentage uncertainty calculations, which were answered correctly by most candidates, whereas part (c)(iii) was more difficult, requiring addition of the percentage uncertainties from (c)(i) & (c)(ii).

In part (d), most candidates identified the need to measure the wire diameter to determine the cross sectional area. They were also able to name the micrometer screwgauge as a suitable instrument. Only the more able candidates were able to identify what the gradient represents and how this can be used to determine resistivity.

Section B

Question 2

Part (a) was answered well by most candidates, achieving both marks available.

Point plotting was accurately done by most candidates in part (b). Some candidates were penalised for inappropriate lines of best fit.

As with ISA P, many candidates still could not achieve the full three marks for determination of the gradient in part (c). The most common error was misreading of one of the data points. This then usually gave a gradient value out of tolerance, hence losing another mark. Some candidates still draw triangles (or use equivalent data points) with sides less than the minimum 8 cm required.

Part (c)(ii) was answered correctly by most candidates.

Part (c)(iii) required the explicit steps detailed in the mark scheme, and was answered well by the more able candidates. Some candidates did not recognise that the length of wire was 1.1 m as stated in the data at the beginning of this question.

Part (d)(i) was a straightforward uncertainty calculation using 0.5 × range. The unit was required and this penalised many candidates.

Part (d)(ii) was a more demanding uncertainty calculation requiring computation and comparison of percentage uncertainties. Again, many candidates did not realise the length of wire was 1.1 m.

Question 3

As with question 3 of ISA P, this question discriminated well with only the most able students achieving three or more marks. Statements given had to match closely with the points listed in the mark scheme.

The question did specifically refer to using a multimeter and therefore, methods using alternative apparatus were unacceptable.

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