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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

Feedback from moderators confirmed that ISA P (SHM) and ISA Q (Capacitor Discharge) 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

Feedback from centres suggested the experiment worked well with few problems. Candidates of all abilities were able to score well on this section with most achieving seven or eight marks. The most common errors were; quoting masses to only one significant figure, graph scales, incorrectly plotted points and inappropriate lines of best fit.

Section A

Question 1

Part (a) was a straightforward question for most students provided their answer included **both** the ruler and the spring. Measuring from the bench to the ruler and using a set square on the spring was the most common method, although use of a spirit level for the ruler was also popular.

This part was more discriminating, and only the higher grade students were able to score four marks in part (b). Although a large proportion of candidates could state the appropriate techniques, the explanations given were much poorer with insufficient detail to justify the mark. Use of a fiducial marker and multiple oscillations were the most common techniques mentioned.

In part (c), the graph should be a straight line with an intercept. Many candidates are confused as to what such a graph represents, incorrectly stating the plotted quantities are 'proportional'. The only acceptable responses for this type of graph were either; a linear relationship, a relationship of the form y = mx + c, **increase** in T^2 is proportional to the **increase** in *m* or where the candidates graph is different to the expected graph. Here credit could be awarded (as ecf) for an appropriate description of the graph.

Part (d) was answered well by most candidates, with reference to repeat readings or closeness of points to line of best fit.

All but the less able candidates answered part (e) correctly, with reference to the same gradient greater value of y-intercept.

Section B

Question 2

Part (a) was correctly answered by most students. The table values must be an exact match to the values quoted in the mark scheme.

Points were usually correctly plotted in part (b) but a proportion of candidates produced poor lines of best fit. The 'off-line' points should be equally spread on either side of the line drawn.

Most students achieved the mark in part (c) for the 'triangle' size with sides of 8 cm minimum. However, the data points were often misread, with incorrect subtraction of the negative x and y values. The gradient value must be within the limits stated in the mark scheme. Error carried forward is not allowed on the gradient value from incorrectly read data points.

Part (d) was more demanding and discriminated well amongst the higher grade candidates. The first two marks were for relating the implied relationship from the formula given with the gradient of the log-log graph. The relationship suggested a gradient of 0.5. The final mark was for explaining why the actual gradient was less than this in terms of either the mass of the ruler and spring not being accounted for in the formula or the uncertainty in the data.

Question 3

Parts (a)(i) & (ii) were standard percentage uncertainty calculations which were answered well by most candidates. They realised the percentage uncertainty in the time period would be the same.

Candidates had to refer to **variation** in reaction time for the mark in part (b).

Part (c) was an easy question, answered well by most candidates.

A wide range of candidates, who were able to substitute values into the formula and obtain the correct value of spring constant *k*, found part (d) quite accessible. There was no significant figure or unit penalty on this question.

Part (e) was a much more demanding question, answered well by only the most able candidates. To calculate the percentage uncertainty in *k*, candidates had to first find the percentage uncertainty in *L, x, m* and T^2 (from doubling the % uncertainty in *T*). This then had to be converted back into the absolute uncertainty in *k* (using the value from 3(d)). The calculated uncertainty had to be quoted to no more than two significant figures, with the final mark awarded for the unit.

Question 4

The most popular answer to part (a) was attaching a card to provide air damping, this part was answered well by a large proportion of candidates.

Part (b) discriminated well. An explanation of measuring the amplitude was often missed. More able candidates were able to explain how to use an ln (amplitude) against time graph to show whether or not the decay was exponential. The mathematical method of taking the ratio of amplitudes for successive oscillations was also correctly described by some candidates.

ISA Q

Stage 1

The experiment worked well with no reported problems. As with ISA P, marks of seven or eight were achieved by a large proportion of candidates. The most common errors were; adding a significant figure to the quoted resistor values, for example quoting 10 kΩ as 10.0 kΩ, inappropriate graph axes, misplotted points, poor lines of best fit.

Section A

Question 1

Time was the most obvious correct answer to part (a), with capacitance (but not capacitor) also acceptable.

Part (b) was a straightforward percentage uncertainty calculation which was answered well by most candidates.

Part (c) was a more discriminating question, answered well by the more able candidates. Whilst many students were able to suggest appropriate factors, the discussions and explanations were often very poor. Reference to reaction time was the most common answer, but without an acceptable explanation.

Whilst many candidates were able to suggest one correct advantage of the datalogger in part (d), only the more able candidates were able to give two. The most common responses related to elimination of reaction time error and higher sampling rate.

Part (e)(i) was answered well by a large proportion of candidates. The intermediate step must have been present to achieve the mark. Part (e)(ii) was also answered well.

Section B

Question 2

For part (a), most candidates identified background radiation and were able to calculate the value of 20 counts/minute. Unfortunately, a large proportion of candidates lost a mark for omitting the unit.

Part (b) was correctly answered by almost all candidates.

Again, the graph points were usually correctly plotted in part (c) but a proportion of candidates were unable to draw a satisfactory line of best fit.

In answer to part (d), most candidates 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 two or three significant figures.

Part (e) was answered well by a large proportion of candidates who correctly calculate the decay constant from the gradient. The half life must have been quoted in minutes.

Question 3

Part (a) provided an easy question, correctly answered by almost all candidates.

For parts (b)(i) & (ii) most candidates were able to correctly calculate the uncertainty and percentage uncertainty from the data provided.

Although many students were able to calculate the appropriate percentage uncertainty in part (b)(iii), a much small proportion appreciated the significance in terms of larger time/larger total count having a lower percentage uncertainty.

Question 4

Only the most able students appreciated the significance of the absorption/spreading out of radiation leading to a smaller count rate in part (a)(i) and the consequent effect on the uncertainty of the in the results.

Part (a)(ii) also provided good discrimination. The same gradient and lower y-intercept were the most popular responses, with only a small proportion of students realising the increased scatter of the points. No explanations were required.

Part (b) was accessible to almost all candidates. Two precautions were required for the one mark.

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