Moderators' Report/ Principal Moderator Feedback

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GCE Physics (6PH06) Paper 1A & 1B

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Introduction

This specification was introduced for teaching in September 2008 and so this unit was available for the first time in June 2010. This year was the second series and there have been significant moves forward b the centres using both assessment routes.

The students are given a briefing paper and asked to produce a plan for a practical investigation; they are then asked to carry out a plan and analyse the data they produce in order to reach a conclusion about the task introduced in the briefing.

Unlike the practical examination there are no time limits or specified date so the centre can set the task for the students when they feel they are sufficiently prepared and similarly the centre can choose the task – rather like coursework – instead of the task being set by an examiner. The conduct of the task is much more like an examination since the candidate may bring nothing into the laboratory nor may they take anything out in between sessions. So the centre retains a great deal of control over the process but unlike coursework there is no draft marking and what the student produces at the time is what is marked. Students should be discouraged from writing unnecessarily; there is very seldom any correlation between length and mark.

The candidates should be given a clean copy of the criteria whilst doing all aspects of the work and this did not seem always to be the case. There should be a line ruled under the completed plan as no planning marks can be awarded after this.

Examiner Tip

Ensure your students understand what is required by each criterion statement. Use the exemplar material in the Tutor Support Materials to help with this. Try getting your students to mark one of the exemplars and go through the marking in class to see if you agree.

General Comments

There are two assessment routes for this unit; the work can be marked by the centre and a sample moderated by Edexcel (route 1A) or the work can be submitted in its entirety for marking by Edexcel (route 1B). Candidates fared equally well along either route.

There are three distinct aspects to this unit; planning, measuring and analysing. The standard of practical work in all three aspects is generally good but often candidates missed marks because they did not address the criteria specifically enough. The criteria are necessarily very short since they must be used for a wide variety of work but they need to be applied in quite specific ways.

Planning is an activity not currently assessed at GCSE so it is a new activity for the students at AS. At A2 candidates are expected to use the AS skills and develop them with a fuller description of the apparatus they need and how it will be used – this year diagrams were generally satisfactory and occasionally good. They are expected to be able to employ a wider range of measuring techniques and to think more thoroughly about how they will gather reliable data.

Implementing and measuring requires candidates to use the appropriate number of significant figures and to show that they are considering uncertainty during their readings. They must refer to the plan; they cannot be awarded the mark M4 unless they do. If they are not going to alter their plan they must say why they think it is working well; one candidate said

'my results showed clearly that as the temperature increased the current went up by more than proportionally, the trend I was expecting, so I did not need to change my plan'.

Similarly the candidate might have said that repeat readings showed only a small variation.

Analysing falls into two parts, there are 8 marks for the graph work and the other 10 refer to the analysis and evaluation. Generally the graph work is very good although it is an area where the better candidates always score more marks. Candidates are then expected to use their results in discussing the uncertainties and their final conclusion. One candidate, having drawn a conclusion said

'since my plots all lie near the best fit line which is straight and the uncertainties for my readings are small I think my conclusion that the time constant is 15 seconds is valid'

This is worth the A17 mark since it refers to the quality of the data and the original aim.

For centres choosing route A, the most significant area for improvement is the award of marks for a high enough standard of work. The marks are awarded for how well the student fulfils the criteria and not for simply carrying out the task; this is by far the largest single reason for a centre to be moderated down.

Plots on graphs need to be checked and then underscored to show they are correct, an incorrect plot should be ringed. Similarly gradient calculations need to be closely checked and best fit lines should not be forced through the origin or join the top and bottom plots. Where the criteria use the words *discuss* or *explain* or *comment* then the candidate should only be awarded the mark if they do significantly more than *state* their case. All these should be in the context of their practical work and not simply be generic ideas.

Examiner Tip

Candidates who scored high marks on this unit had clearly practised on similar tasks. Just as with a theory paper candidates do better when they rehearse the 'real thing'. Use the tasks in the Tutor Support Materials to give your students some practice.

The Criteria
A: Planning

Ref	Criterion	
P1	Identifies the most appropriate apparatus required for the practical in advance	This is usually a list
P2	Provides clear details of apparatus required including approximate dimensions and/or component values (for example, dimensions of items such as card or string, value of resistor)	Meter ranges, range and size of masses, dimensions of card and mass for damped pendulum are expected – this is an extension of P1
P3	Draws an appropriately labelled diagram of the apparatus to be used	Diagrams should be dimensioned and labelled and representational, for example, rulers should be drawn close to the measured length. The diagram can help score P2.

P4	States how to measure one quantity using the most appropriate instrument	Any quantity
P5	Explains the choice of the measuring instrument with reference to the scale of the instrument as appropriate and/or the number of measurements to be taken	It is not enough to quote either the range or the precision, or both, without reference to the experiment. A good student said '*the stopclock has a precision of 0.01 s which is less than the uncertainty of the manual operator which is likely to be 0.1 s'*. Another '*the uncertainty of 0.005 V in a meter gives a % uncertainty of 0.7% in a typical measurement of 0.7 V as in the forward bias voltage of the diode in this experiment'*
P6	States how to measure a second quantity using the most appropriate instrument	Again, any quantity, it does NOT have to be one of the variables
P7	Explains the choice of the second measuring instrument with reference to the scale of the instrument as appropriate and/or the number of measurements to be taken	As for P5
P8	Demonstrates knowledge of correct measuring techniques *Award common on 'tracks'*	Good candidates drew on their own experiences when planning the readings. A timing marker at the centre is one technique. Another is using the laptimer to record the time when the voltage reaches a certain value - this is much more accurate than trying to read 2 meters simultaneously. The technique used should improve the measurement.
P9	Identifies and states how to control all other relevant quantities to make it a fair test *Candidates tended to control everything, in many cases to no effect*	'All the variables' is the key here. If there are none to control the candidate should explain why. A_0 in the pendulum and 'supply voltage' in the capacitor experiment should be recorded and checked
P10	Comments on whether repeat readings are appropriate for this experiment	Repeats are appropriate if they improve the reliability and accuracy of the data. Candidates should explain why this is the case, it is not enough to say that repeats will be taken. Candidates must say that a mean value is obtained
P11	Comments on all relevant safety aspects of the experiment	Only sensible remarks were read. If there are no safety concerns then that should be explained – 12 V electricity is safe *because* it will not give the careless user a shock. The power supply unit might need more thought. It is acceptable to state why the experiment is safe – perhaps because masses are small and

		since velocities are small the energies are modest.
P12	Discusses how the data collected will be used	In effect a comparison with the equation of a straight line is expected. Deriving the experimental equation will help with A10 too. He use of the graph to find the constant must be pointed out as must the sign of the gradient if negative.
P13	Identifies the main sources of uncertainty and/or systematic error	This refers to the method as well as the measurements
P14	Plan contains few grammatical or spelling errors	This refers only to the plan and principally the technical terms and their use.
P15	Plan is structured using appropriate subheadings	Many good candidates followed the marking grid – which is fine but some headings are still needed.
P16	Plan is clear on first reading	Is the written communication clear? Clarity in describing the actual method is what is looked for. Many candidates did not explicitly state a method, perhaps because there is no marking point other than this one.

B: Implementation and measurements

Ref	Criterion	
M1	Records all measurements with appropriate precision, using a table where appropriate	The numbers should show the precision of the measuring instrument, P5 & P7 should concur. A common mistake is to record time in seconds as 10, 20 instead of 10.0, 20.0. The latter suggests a precision ten times better and which is probably true
M2	Readings show appreciation of uncertainty	Best is ± at top or bottom of table since candidates are expected to appreciate the uncertainty in what they are reading.
M3	Uses correct units throughout *measurement*	This is for using correct units throughout *measurement*
M4	Refers to initial plan while working and modifies if appropriate	Candidates must say why no modification was needed if none was done. This i to encourage candidates to view there readings critically.
M5	Obtains an appropriate number of measurements	Usually at least 6 to plot a linear graph
M6	Obtains measurements over an appropriate range	Are the points evenly spaced or bunched near a sharp change? Is the candidate thinking about the measurements as the work proceeds? A rule of thumb is for the independent variable to double in value.

C: Analysis

Ref	Criterion	
A1	Produces a graph with appropriate axes (including units)	The quantity plotted determines the units of the gradient, so logarithmic quantities must be dimensionless. The plot is thus ln (x/m) for example. This mark was very often lost by candidates.
A2	Produces a graph using appropriate scales	Data must occupy half of *page* on both axes and scales and must be simple so that gradient calculations and interpolation are easy. The origin need not be shown
A3	Plots points accurately	Two plots are checked, these should be underscored, misplots circled. Choose the two most off the line.
A4	Draws line of best fit (either a straight line or a smooth curve)	Lines must have plots on both sides. It is unlikely that the Best Fit Line will join the top and bottom plots and it must not be forced though the origin as is often the case with the Force – extension graph for an expendable spring, these have pre-compression and the graph never passes through the origin.
A5	Derives relation between two variables or determines constant	This is for the link to the constant in the briefing with negative signs where appropriate
A6	Processes and displays data appropriately to obtain a straight line where possible, for example, using a log/log graph	The evidence is the appropriate graph
A7	Determines gradient using large triangle	At least half of the drawn line in size and the gradient calculation must be correctly measured, using data points is almost always imprecise.
A8	Uses gradient with correct units	There might be no unit, as in a log-log graph
A9	Uses appropriate number of significant figures throughout *calculations*	This is for using appropriate number of significant figures throughout *calculations*
A10	Uses relevant physics principles correctly	This mark is for the use of good physics seen anywhere, use of mathematics in showing why the chosen line is straight is one way of doing this. A relevant description of the physical change that explains the results is another. One candidate said '*the temperature rise releases more charge carriers meaning that the current rose at constant voltage*'
A11	Uses the terms precision and either accuracy or sensitivity appropriately	These can be seen anywhere, some candidates discussed them in the plan
A12	Discusses more than one source of error qualitatively	This is a *review* of the uncertainty in the light of P13 and experience of doing the experiment and must be based on the evidence from the method/results/graph
A13	Calculates errors quantitatively	A % uncertainty is expected on the

			dependent variable at least
A14	Compounds errors correctly		This can be gained by *using* error bars, it is not enough just to draw them. Error bars can be all the same size candidates are not expected to calculate them for each plot.
A15	Discusses realistic modifications to reduce error/improve experiment		Good candidates explained how the modification improved the readings. Candidates who said '*use a datalogger*' without explanation did not get the mark.
A16	States a valid conclusion clearly		This should refer to the aim and is an easy mark.
A17	Discusses final conclusion in relation to original aim of experiment		This should refer to the quality of the data. The best candidates compared the % uncertainty and the % difference to back up their conclusion
A18	Suggests relevant further work		Further work should be both relevant and realistic. It should aim to be the non-trivial follow-up experiment that could be performed by the same student in the same laboratory. This is usually given insufficient weight by candidates and the mark not awarded.

Examiner Tip

When your candidates have carried out one of the exemplar tasks ask them to mark each others' work and use the resulting discussions as a training exercise.

Administration points

It was difficult to give some candidates credit because the briefing sheets were not included, this can reduce the mark awarded. Each candidate's work should have the candidate's briefing paper attached along with the signed Candidate Record Form plus any other papers that were issued such as an Edexcel plan; for route 1A the mark sheet should be with these as well. It is a good idea to check that the marking grid agrees with the mark on the script.

It is a great help to all if the candidates can write on only one side of the paper in black ink. Each sheet should be named and numbered in order and all the sheets connected with a treasury tag. Since the work is all carried out in examination-style conditions this should be easy to achieve.

EXAMINER'S TOP TIPS

Most candidates could improve easily by looking closely at
P5, P7, P13, M1, M4, A1, A9, A13 and A15

Grade boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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