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November 2011

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Principal Moderators' Report on Internal Assessments Activities (IAAs) in GCSE Science, Additional Science, Biology, Chemistry and Physics

November 2011

Overview

The Principal Moderators are very pleased to report that although there were a smaller number of entries than the summer, the vast majority of Centres made internal assessments, which were identical to, or close to, those of the moderating team. Most Centres have taken on board the advice given in training, the guidance materials for Series 5 from the website, previous E9's, and the Principal Moderators' report from November 2010 and July 2011.

As Series 4 IAAs are no longer available all those seen were from Series 5 Core and Additional Science. The Series 5 IAAs will continue to be valid until March 2013: there will be no series 6. Most centres are referring to the published guidance materials, and this has helped them standardise across the disciplines. The annotation seen on most scripts was also more detailed, and referred to the guidance material. This made it easier for moderators to see where centres were awarding marks.

The IAAs continue to discriminate well between students of different ability levels. The marks achieved ranged from single figures to the maximum mark of thirty-six. However, where single figures were seen, the main reason was still a lack of any response to some questions rather than completely wrong answers. There was an increase in the number of students achieving higher marks, and this may reflect the amount of time centres are putting into AfL and making sure that the students are adequately prepared for the IAA.

It was also very clear that in almost all centres, the advice relating to the conduct of the suggested practical work had been followed and that their students had benefited as a result. There were few examples of centres adapting the practicals, although Centres are reminded that if they are thinking about changing any part of the published practical, then they should first discuss this with Edexcel (via Ask The Expert). Following the completion of practical work relating to each IAA, teachers are advised to spend some time with their students giving hints and tips about generic issues such as the detail which must be included in the writing of a plan, the meanings of terminology such as 'reliability' and 'validity', how best to present data in graphs, how to describe the pattern in a graph using scientific ideas, and how best to deal with the data in coming to a conclusion.

Just prior to the taking of the IAA by students, the relevant "students information sheet" should be given to them (please see the rubric for each IAA). The IAA itself can then be taken either in formal exam conditions, or in controlled conditions in the classroom/laboratory, as deemed most appropriate by the staff in each centre.

Where students' answers would benefit from a diagram but there is no space allocated, many seemed to assume that they were meant to use 'a thousand words' instead. Centres should encourage students to use relevant and useful diagrams if this helps their answer.

Following the teacher assessment, extracts from student work can be used for formative assessment in preparation for students taking subsequent IAAs.

Teachers are advised to read the rubric for each IAA carefully, especially with regard to the attachment of student graphs from in-class experimental work. Some IAAs will require these graphs, others do not. The majority of centres now routinely send graphs attached to students' work.

It was evident that in the majority of centres, science teachers had carefully applied the assessment criteria and had carried out internal standardisation in a professional manner. There was, however, evidence from a number of centres that the work had been "remarked" by another teacher. In instances where these two marks agreed, there were few problems, but there were a number of centres where the two marks disagreed significantly, and this showed that the centre had not standardised. It was not clear in these instances why the centre had favoured one marker over another. In a number of instances the first marker had been more in line with the moderator. Centres are advised, in situations like these, to discuss the range of marks and reach a joint decision that can be supported by the department. Where there were disagreements between the script and the OPTEMS, it was because an average of the two marks had been put on the OPTEMS but not the script.

Generic Assessment Grid

Levels of Performance Stages	Mark Band 1 Performance not worthy of credit	Mark Band 2 Low level performance	Mark Band 3 Standard level performance	Mark Band 4 High level performance
Planning	Students can only give isolated facts not specifically related to the task under consideration 0 Marks	Students can a. show some awareness of how scientific information can be collected b. plan a simple scientific task 1 – 4 Marks	Students can a. show awareness of how relevant data for a task can be collected b. plan a scientific task to collect relevant data 5 – 8 Marks	Students can a. show awareness of how valid and reliable data can be collected b. plan a scientific task to collect valid and reliable data 9 – 12 Marks
Principal Moderator comments:	*At this mark band candidates cannot produce any kind of a coherent plan, or draw an appropriate diagram.*	*At this mark band a simple description of a plan is all that is required. It may well be incomplete and / or inaccurate. Any simple diagrams may be inaccurate and /or incomplete.*	*At this mark band candidates normally provide a logical and fairly detailed account of their in class work and can sometimes apply the skills learned to a new situation. Any diagrams are normally sufficient to convey understanding and are labeled appropriately.*	*Candidates normally provide a very good account of their plan, and/or draw fully labelled diagrams in this mark band. They are clear about the meanings of validity and reliability. Candidates understand the need to change only the independent variable, and they know the reasons why readings are repeated, means taken, and how anomalous results should be dealt with.*
Extracting information and using data.	Students can only repeat information given without selectivity and make no further use of the data 0 Marks	Students can a. present data in a simple way b. identify simple patterns in data 1 – 4 Marks	Students can a. present data as instructed b. identify patterns in data using scientific ideas 5 – 8 Marks	Students can a .choose an appropriate method of presenting data b. identify detailed patterns in data applying relevant scientific principles. 9 – 12 Marks

Principal Moderator comments	*At this mark band candidates are unable to draw any sort of graph or suggest what any type of graph shows.*	*At this mark band candidates can normally spot errors in graphs, and / or complete simple bar charts. They can normally state what the graph shows in a simple way i.e. "as X gets bigger Y gets smaller", "the graph goes up" or similar.*	*At this mark band candidates can draw a simple bar chart, or complete a line graph using information from a data table. In addition to stating what the graph shows, they can normally say "the graph is linear", "there is a positive correlation" or similar, but with little or no further comment or explanation.*	*At this mark band candidates can normally correctly scale the axes of a graph, label the axes, plot the points accurately and draw an appropriate line of best fit. They can also explain terms such as directly proportional or inversely proportional etc., referring to the graph they have drawn, giving quantitative examples of the relationship shown.*
Interpretation judgement and opinion	Students can only repeat the information given and offer no relevant interpretation, judgement or opinion. 0 Marks	Students can a. draw a simple conclusion using data in an elementary way b. make a valid comment on procedures and / or results c. recognise a benefit and / or a drawback of a simple, familiar, scientific development 1 – 4 Marks	Students can a. draw a conclusion showing awareness of the appropriate science using data qualitatively and/or quantitatively. b. make valid comments showing awareness of the appropriate science c. recognise benefits and /or drawbacks of scientific developments 5 – 8 Marks	Students can a. draw conclusions showing detailed appreciation of the appropriate science, using complex data qualitatively and / or quantitatively. b. evaluate the strength of the evidence and / or suggest how validity and / or reliability of results can be improved. c. demonstrate a good understanding of benefits and /or drawbacks of scientific developments 9 – 12 Marks

Principal Moderator comments	*At this mark band candidates are normally unable to attempt any meaningful comment on data, text, or graphical information presented to them.*	*At this mark band candidates are normally able to offer a simple conclusion, and a meaningful comment on the method used or the results obtained. They can normally also give a relevant comment on a simple scientific development.*	*At this mark band candidates can normally explain a conclusion using relevant scientific understanding which may be either qualitative or quantitative. They can offer opinions on the results or graphs showing some awareness of the relevant scientific background. They can also discuss in a simple way the benefits and / or the negative aspects of scientific developments.*	*At this mark band candidates show a good understanding of the results, or graph, can go on to perform a complex calculation, and / or discuss in detail the finer points of a complex graph – ie the need to take more points around a peak or trough to be sure of the shape, etc. They can discuss where further evidence (ie more data points) is needed, or state giving reasons, if they think there is sufficient evidence for a firm conclusion. Given some data they can identify how validity and / or the reliability of the task can be improved. They can also discuss in detail the benefits and / or the negative aspects of recent scientific developments.*

Comments on each Section

Planning

Planning was tackled well by many students, although a significant number still fail to give sufficient details of their method – for Mark Band 4 there must be everything needed for a third party to accurately reproduce the experiment from the account provided. This means that all the details, including how variables were controlled, must be included.

There has been a dramatic drop in the number of students who still have difficulty with the concepts of reliability and validity, and the number who confuse them. However, some centres are still awarding high marks for reliability where students say no more than “do three repeats and calculate the average.” This lack of depth and clarity means that centres are often generous when marking this section. In Mark Band 4 students need to show some understanding of why repeats are useful i.e. to check that results are all similar (concordant), to look for anomalies or to remove or repeat results that do not fit the pattern. For validity, simple statements like “keep everything the same” or “make it a fair test” are not sufficient in Mark Band 4. Students will need to discuss which variables they need to control and how they need to control them. Some students are still drawing very poor diagrams, which were more artistic than scientific.

Extracting Information & Using Data

Most students were able to spot errors in tables and complete gaps in averages, etc. It was encouraging to find a better understanding of the distinction between discrete and continuous data when it came to choosing which type of graph to draw. It is, however, interesting to see that more students were able to choose the right type of graph than were able to explain why they had chosen it. In questions where students had to discuss their choice phrases like ‘there were two sets of numbers’ and ‘it is easier to see the information with a bar chart’ are still used. Some centres were encouraging students to use curves for discrete variables like number of carbon atoms when dot-to-dot would be expected, especially at MB4. A few students still make improper use of the graph paper and this often prevents them achieving a high mark, as they are then unable to identify changes of gradient. Non-linear scales are also seen, and again this distorts the line and means that the patterns are not always obvious. Students do not need to start their scales at zero, but if they do not, they must indicate this, usually with two small parallel lines crossing the axis. In this instance, they must not take the line of best fit back through zero.

There were a number of cases of graphs plotted but with no lines drawn and a few cases where students seemed determined to draw a straight line as the line of best fit whatever the general trend of the points plotted. The fact that this was sometimes ticked and credited may indicate that they were following advice by their teachers. As part of the Mark Band 4 “identify detailed patterns”, students are expected to discuss changing gradients, and if they have forced their line of best fit in to a straight line, they will be unable to do this.

There were some instances were centres had given all their students A4 graph paper to plot data from tables within the IAA instead of expecting them to use

the grid supplied on the paper. Part of the skill at MB4 is devising a suitable scale for each axis within the limits of the grid supplied. Students with access to larger graph paper do not therefore have the opportunity to illustrate this achievement in the same way. If a student mis-plots or ruins the graph paper in the script it is, of course, acceptable for the centre to provide more paper but this should ideally be to the same scale and size if the original piece.

Interpretation, Judgement & Opinion

This section of the IAA presents students with the greatest challenge, and this is usually reflected in lower marks compared with Planning and EIUD. There also tends to be a higher proportion of incomplete and unanswered questions in this part of the IAA: either because of an inability to answer them, or possibly due to lack of time. Some Centres marked rather generously, commonly annotating the work with words such as “implied” when the candidate has clearly not provided an answer in line with the banding proposed.

The same issues arise with reliability and validity in this section as in Planning. Some centres awarded high marks for very simple statements e.g. for reliability comments such as “repeat and average”. Students cannot score in Mark Band 4 for these simple statements: they need to show an awareness of how the process of repeating can increase the reliability. This means that they must look at comparing their repeats in order to determine if they are concordant (the idea, not necessarily the term itself). This will depend on the nature of the experiment e.g. which differences can be considered slight, and which can be considered significant and are therefore anomalous. They then need to suggest what they might do with these anomalies, e.g. remove from the average or repeat again.

In the two IAAs where the precision of an answer was addressed, it was very rare for students to realise that they were making the data “more” precise than the equipment they were using! Students need to be encouraged to see that more decimal points does not necessarily lead to improved accuracy, and that processed answers can only be as accurate as the primary data they are based on.

Additional Comments on Individual Series 5 IAAs

Core

B1a Topic 1: Where this was attempted, there was often a poor understanding of validity, and which variables needed to be controlled. This was also seen in the plans students wrote at the bottom of page 3. Some students were also unclear on how to measure growth in the duckweed. Many students drew a straight line of best fit for the graph on page 5 but then talked of “tailing off” which contradicted their choice of line. Centres are reminded that this IAA is about growth in duckweed and not directly about photosynthesis. Experiments on light intensity and bubble counting may not prepare students adequately for the rest of the questions in the IAA. In EIUD students sometimes drew their pyramids (page 6) upside down. Few were able to state that the amount of energy available at each level was a feature of the pyramid of biomass.

B1b Topic 3: There were more examples of this IAA in this session than in the summer and although many still found it difficult, there was some high quality

work seen. A frequent error on page 3 was that candidates failed to mention how they would measure the effect of smell on taste.

C1a Topic 5: A small number of centres used this IAA. However, many were confused about the second method, with many just giving the method for the practical that they had already completed. Those who gave the right method missed key parts e.g. washing and drying the copper precipitated in the reactions.

C1b Topic 7: This was still the more popular Chemistry IAA and students were able to show a good understanding of the experiment regardless of their final level. Lower ability students did not, however, seem to appreciate what was required in the second method, and some did not vary the number of candles. Only a few candidates discussed allowing air in between experiments although many sealed the jars. There were some that described cleaning soot out from the jar between each experiment to keep the volume the same, which shows a good understanding of validity. Some students did not recognise that processed results could not be more precise than their original measurements. Many students struggled on the IJO section because they did not compare the two methods of preparing ethanol, as the question asks. Some students outlined the two methods without offering some comparison, and others gave environmental advantages and disadvantages to burning fuels *per se*.

P1a Topic 9: This was the more popular Physics IAA with many excellent answers seen. Some candidates did not appreciate that on page 7 the anomaly made it difficult to see the pattern so the addition of two more points gave greater confidence in the shape of the graph. On page 9 full marks could be obtained by those candidates who did rather more than state “more functions” in answer to the first question. What was expected was some indication of how the extra functions were beneficial to the owner.

P1b Topic 12: Although there were few seen, this IAA was done successfully; with most students understanding clearly what was expected.

Additional

B2 Topic 2: Most students did very well on pages 4 and 5 but there is only one graph, and therefore, even though it is a bar chart, can allow access to mark band 4. Then with some astute observations on page 6, and with the idea of more light at the top of the tree than lower down, mark band 4 attainment can be confirmed. Most centres didn’t realise this, and annotated perfect graphs as mark band 3. Validity and reliability were again often confused and poorly attempted. A lot of candidates just wrote a long list of reliability and validity issues, but didn’t distinguish between them.

B2 Topic 3: For this, candidates were expected to use hydrogen carbonate indicator to investigate the rate of photosynthesis in pondweed. Some centres changed this to the more traditional ‘counting bubbles experiment’. Students who did this then struggled in IJO when they were referred back to the hydrogen carbonate indicator and did not understand the question. Centres are reminded that teachers can have access to the IAAs as part of their planning, so can see how the rest of the IAA is dependent on the correct practical.

C2 Topic 5: There were more examples of this IAA seen in this session with some achieving the highest marks. Centres need to remember that both graphs (on pages 4 and 6) should be drawn with straight lines joining the points, as in both cases the X axis is not a continuous variable. The discrete variable nature of 'number of Carbon atoms' means that best fit straight lines or curves are not appropriate.

C2 Topic 6: There seemed to be variation in the level of understanding of the practical work for this IAA. Centres are advised that they can use "Ask The Expert" if they are unclear about how to present this IAA. Most candidates gave a good diagram on page 3 but failed to indicate how the electrode depth was to be measured. Again, candidates often drew a line graph with a smooth curve when drawing a graph for atomic number (page 6), instead of a dot to dot line. With the graph on page 8, students can label the axes either way round, as both are acceptable based on the information they are given in the rubric of the question. Once the graph is labelled, the rest of the questions must give answers deduced from it. The order of these answers will depend on which way round students have labelled the axis.

P2 Topic 9: There seemed to be variation in the level of understanding of the practical work for this IAA but there were few examples seen so it is difficult to comment. It is useful to note, however, that one centre used a device called a "push pull Newton meter" to undertake the experiment. With this type of spring attaching masses compressed the spring. This is a valid approach to the task, however the candidates need to make clear what they are doing and explain that the spring is being compressed.

P2 Topic 11: Students seemed to understand the practical they had completed and were able to discuss it. There were some good plans (on page 3) seen but few candidates were able to comment on the change in gradient of the graph (on page 4). There was some confusion when explaining how the reliability could be improved, with very few students identifying that radiation is random, so there is a need for more repeats.

Administration

There were a number of centres who sent work late or who needed to be reminded by moderators that the deadline had passed. Many had entered by mistake and therefore withdrew students to re enter in May 2012 instead. The submission date is on the key date document and is the same ever year.

Many centres did not put centre and candidate numbers on the work which made checking marks time consuming.

The annotation of scripts continues to improve, although there is still a minority of centres who just tick. Centres, that gave thorough annotation, to show why marks had been awarded, were generally in closer agreement with the moderators' marks. In some centres it is clear that the IAA's are being used as part of the student's formative assessment (AfL). These scripts with "student friendly" annotation to show links to criteria and targets for future work were very useful in showing the moderator how the centre had arrived at the mark. This good practice not only allows students to show progress in their IAA's but also aids the moderation process. The minimum requirement for moderation, however, is simple statements of band for example:

- “low band 3”
- “upper band 4”
- “just into band 2” etc.

Such comments should be added alongside the work, at the point of achievement. If sufficient of these annotated comments are made in each skill area, it makes the final judgement as to the overall quality of the work in each skill area much easier.

Evidence of internal moderation was seen and in many cases was clearly effective. However, care must be taken to ensure that standardisation is a dialogue between professionals and not just a remark by another teacher. Where work was “remarked”, it was usually the second person’s mark that counted. This is not true standardisation and means that the centre is dependent on the expertise of the second marker rather than allowing the sharing of good practice across the department.

In some Centres the questions on some of the scripts were given numerical marks, which were then aggregated to arrive at a total. This is an inappropriate procedure as it defeats the purpose of a generic grid, and is not recommended. In cases where there are two sections to each skill area, teachers must judge the quality of the work as a whole across both sections of the skill area.

Some centres apparently did not give students the opportunity to do the recommended practical work before commencing the IAAs, and in some centres computer simulations or teacher demonstrations were used. Students who had actually performed a practical experiment, in general, performed better in terms of being able to plan and discuss improvements to the experimental design. This procedure also allows for variation in the quality of diagrams – those doing simulations invariably drew very similar diagrams. It is not recommended for students to draw the pieces of individual apparatus – we would prefer to see the assembled apparatus, with each item labelled.

Some Centres chose to alter the design of the experiments rather than follow those in the teacher guidance. This practise often meant that students were disadvantaged in other parts of the IAA. If a centre feels it is unable to complete a particular IAA then they should use another one in the series rather than adapt.

Full and detailed answers to the reliability and validity questions are the discriminators for band 4 marks, especially in the planning section. (Please refer to the glossary “Definitions of some Useful Scientific Words” published in February 2009 for full details of the meanings of the terms reliability and validity). When discussing reliability, most students were able to say “repeat the test”, but many were unable to go on to discuss the treatment of anomalous results, the obtaining of concordant data, and the averaging of concordant results. To many students validity simply meant “fair testing”, though many failed to expand on the meanings of these words, i.e. to discuss the controlling of all variables except the independent variable. Many centres

still gave too much credit for answers that did not distinguish between reliability or validity and were too general.

For July 2012

The current set of IAA's (series 5) was published in June 2010. This is now the only set that will be available for the remainder of the life of the Specification.

Further Support

- Centres are advised to make use of the free consultancy scheme for IAAs. Centres can send up to three marked IAAs per GCSE subject, (Science, Additional Science, Biology, Chemistry or Physics) to a Principal Moderator in order to receive advice on their standards of assessment. (Note - an updated Consultancy service document is now available via the 360 Science website).
- There is detailed guidance on series 5 IAA's that give centres an idea of the type of student responses expected within each mark band.
- Teachers can continue to send in queries and questions via Edexcel's "Ask The Expert" email service. These questions are normally answered within two working days by either the subject adviser at Edexcel, the Chief Examiner, or a Principal Moderator.
- There is a list of frequently asked questions (and the answers) relating to IAA issues on the 360 Science website. This was last updated in January 2009.
- There is written assessment guidance material available via the 360 Science website. Please see also the booklet "Internal Assessment Guidance for GCSE Science (2101) and GCSE Additional Science (2103)" published May 2008.
- Exemplar IAAs in Biology Chemistry and Physics are available on the 360 Science website.
- Exemplar student work in Biology Chemistry and Physics IAAs, with moderated marks and commentaries, is available on the 360 Science website.
- "Definitions of Some Useful Scientific Words" (including the meanings of accuracy, concordant, precision, reliability, validity etc.) was published in February 2009 and is available on the 360 Science website.

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