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Examiners' Report November 2009

Internal Assessment Activities (IAAs)

GCSE

360Science

GCSE Science (2101)
GCSE Additional Science (2103)
GCSE Biology (2105)
GCSE Chemistry (2107)
GCSE Physics (2109)

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November 2009

Contents

Principal Moderators' Report on Internal Assessments Activities (IAAs) in GCSE Science, Additional Science, Biology, Chemistry and Physics November 2009 Moderation of IAA's

Overview

The Principal Moderators are very pleased to report that 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 updates on the 360 Science website and the guidance given in their own E9's and the Principal Moderators report from Summer 2009.

Several centres took this moderation window as an opportunity to assess and have moderated the newest series 4 IAA's, though the majority seen were series 3 IAAs (which continue to be valid until summer 2010). There were very few Additional Science scripts seen for either series 3 or series 4.

The Principal Moderators are pleased to report that it was sometimes possible to raise more centre marks than has been the case in the past.

The IAA's continue to discriminate well between candidates of different ability levels. The marks achieved ranged from single figures to the maximum mark of thirty six. Although, where single figures were seen, the main reason was lack of any response to some questions rather than completely wrong answers.

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.

Teachers are advised to read the rubric for each IAA carefully, especially with regard to the attachment of candidate graphs from in class experimental work. Some IAAs require these graphs, others do not. The majority of centres sent graphs attached to student's work and this was an improvement on the summer**.**

It was also very clear that, in almost all centres, the advice relating to carrying out the suggested practical work had been heeded and that their candidates had benefited as a result. When students used a computer simulation, however, they were less able to discuss the variables and often gave very little detail of their experiment.

Just prior to the taking of the IAA by candidates, 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 or laboratory.

Where candidates' 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 candidate work can be used for formative assessment in preparation for candidates taking subsequent IAA's.

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 Individual IAAs

Unit 5002 (Science -Biology)

B1a topic 1: Investigating germination: Centres are advised that fresh seed should be used for this investigation, and that natural variation in germination rates is to be expected. In EIUD b) candidates were able to identify patterns in the data which would take them into Mark band 3. To improve their performance, they should use scientific ideas to support the pattern they have seen, for example, one group of seeds germinated faster than the other then slowed down because
To reach mark band 4 they need to apply relevant scientific principles to the pattern and candidates could refer to physiological processes within the seeds, and/ or the effect of competition.

B1b topic 3 Investigating reaction times:- Some centres used a computer program here, but that unfortunately may make it difficult for the candidates to comment on the taking of valid and reliable results. Some students gave vague "recollections" of shooting sheep rather than any detail about how this measured reaction time. Many assumed that "we used the sheep program" was all they needed to say to explain what they did.

Carrying out the actual practical work is recommended here. In EIUD candidates often tended to describe the more obvious pattern, e.g. "as the concentration of caffeine increases the reaction time decreases" but most did not go further and describe a numerical pattern e.g. "as the concentration of caffeine increases by 100mg dm^{-3} the reaction time decreases by 5 ms." A bar chart is inappropriate for presenting data where the key independent variable was the continuously varying concentration of caffeine. A number of students presented bar charts for this exercise.

Unit 5003 (Science - Chemistry)

C1a topic 5 Investigating temperature changes during chemical reactions:- In the planning section one suggestion for the taking of valid results would have been the use of an insulated polystyrene beaker (or similar) to reduce heat loss to the surroundings. In EIUD it is not necessary in the final question for candidates to suggest an explanation in terms of the oxide layer – they could just say that aluminium does not react because something prevents the metal from reacting as it should – (as shown by its position in the reactivity table) – with the copper sulphate solution. Some students linked the aluminium result to the magnesium ribbon from their own experiment. As a validity point in the plan many students said they needed to be clean the magnesium ribbon with emery paper to remove dirt or surface reaction. They then applied this to the aluminium: this application of good practice in practical work is HSW. In IJO credit for the graphical question should be awarded on the strength of the arguments (for or against) put forward by candidates.

C1b topic 7 Heat from burning alcohols:- A labelled diagram showing the assembled apparatus received more credit than a pictorial apparatus list. In EIUD there was still poor understanding of the difference between discrete and continuous variables; many candidates still state that a bar chart is clearer. Centres are advised to spend more time on discussing with candidates when bar charts or line graphs are appropriate. The question on bio-fuels gave variable quality of answers but the best candidates were able to give points both for and against the use of bio-fuels.

Unit 5004 (Science - Physics)

P1a topic 9 Investigating light dependent resistors:- Candidates could improve their performance in planning by having a clear understanding of the terms "independent variable" and "dependent variable". There was some confusion between measuring brightness and resistance and few candidates controlled the external brightness of light. In IJO, improving validity may be achieved through a consideration of a wider range of results when using Mike's computer.

P1b topic 11 Investigating sound:- A diagram in planning is optional, but it may help candidates to clarify their answers. In some of the centres which had not actually performed the practical work for this experiment, the method described in the plan was wholly impossible, given the apparatus described, yet it was described as actually being undertaken. These Centres awarded very high marks for a description that was invalid and patently unreliable. Although candidates were generally able to draw in the best fit line for the graphs in EIUD, some could have improved their performance by the careful plotting of points and / or the drawing of a thin best fit line (ie without the use of "tram lines").

Unit 5012 (Additional Science – Biology)

B2 topic 1 Measuring the effects of exercise :- Candidates were generally able to achieve band 2 in planning but they could have improved their performance by listing the steps taken, in order, and by giving some information regarding the measuring instruments they used. In EIUD more able candidates could provide scales for the axes which made good use of the graph paper provided. In IJO candidates need to identify which investigation they are referring to when improving reliability.

B2 topic 3 Investigating the effect of variables on the rate of photosynthesis:- In general candidates could describe the steps taken in their investigation, though answering the question on the collection of valid and reliable data was often difficult for those candidates who had done a computer simulation. Only the more able students were able to offer an explanation for the shape of the graph in EIUD.

Unit 5013 (Additional Science – Chemistry)

C2 topic 5 Finding a chemical formula by doing a practical experiment:- A labelled diagram showing the assembled apparatus received more credit than a pictorial apparatus list. In EIUD the most able candidates were able to describe the direct proportionality shown by the graph quoting quantitative figures from the graph. In IJO candidate performance could have been improved by reference to the oxide which is released into the air, as the lid is periodically raised. Candidates were generally able to complete the calculation.

C2 topic 6 The alkali metals halogens and their compounds:- Most candidates could attempt a diagram of the apparatus used to electrolyse sodium chloride solution, but only the more able were able to adapt this diagram to one appropriate for the collection of copper from copper sulphate solution. In EIUD candidate performance could have been improved by realising that the boiling points given were too high for Bunsen burners to reach, and knowing that a bar chart is preferable to a line graph where the data are discrete.

Unit 5014 (Additional Science – Physics)

P2 topic 9 Investigating acceleration:- A number of Centres varied force instead of mass and it was obvious from the candidates' responses that there was confusion between mass and weight. It was also noted that some Centres used a slope to provide the force to accelerate a car/trolley and then changed the mass of the car/trolley. Acceleration was found from time and the distance down the slope. This does not work as the velocity at the bottom of the slope is independent of the mass using $\Delta GPE = \Delta KE$.

P2 topic 11 Investigating a model of radioactive half-life:- A diagram in planning is optional, but it may help candidates to clarify their answers when writing about their plans. In EIUD performance was enhanced when candidates showed on the graph how they had arrived at their answers. Although candidates were generally able to draw in the best fit line for the graphs in EIUD, some could have improved their performance by the careful plotting of points and / or the drawing of a thin best fit line (ie without the use of "tram lines").

Series 4 IAAs

Unit 5002 (Science -Biology)

Topic 4 was the most often seen of the two series 4 IAA's. Many of the points raised in Series 3 Topic 3 are pertinent here i.e. the mention of "shooting sheep" without details of how the program was used. Although the bar chart was plotted correctly many students superimposed both pieces of data on the left of the *x* axis, rather than drawing Holly's reaction times on the graph to the right of Joe's reaction times.

Unit 5003 (Science - Chemistry)

C1a Topic 6: In the planning section students had an idea of how to produce both soluble and insoluble salts but often missed out the details i.e. add excess magnesium powder to show complete reaction or wash the insoluble salt, lead iodide.

C1b Topic 8:.In EIUD the pie chart and the bar charts were completed well with the vast majority of students able to discuss the scale as the reason for using two graphs for the data. There was still confusion over continuous and discrete data as many students correctly chose a line graph but could not say why. Most students were able to give advantages and disadvantages of drinking wine in terms of the resveratrol it contained.

Unit 5004 (Science - Physics)

P2 Topic 11: This was the only Core Physics Series 4 IAA seen this time. Students were able to describe what they did although the quality of the accompanying diagrams was variable. Many students calculated the averages including the anomalies even when they discussed reliability and said that anomalies should not be included in the average. This suggests repeating stock answers rather than really understanding what they were saying. A significant number of students did not understand how to increase the strength of the evidence. Instead they discussed how to improve reliability and validity. Again this suggests that students are answering the questions they expect to see rather than reading carefully. There was some confusion about which way to place the axes on the graph of angle A against angle C. The majority of students were able to discuss the advantages and disadvantages of the automatic window screen wipers.

Unit 5012 (Additional Science – Biology)

B2 Topic 4: This was the only Additional Biology Series 4 IAA seen this time. These were answered well with the majority of students able to plot and discuss both graphs and relate these to their conclusions.

Unit 5013 (Additional Science – Chemistry)

C2 Topic 7: There were some excellent discussions of the graph seen here. However, this seemed to be something they could either do or they couldn't, there were very few students who scored in the middle band for this.

C2 Topic 8: Students were able to recall their practical but were often less able to plan the calcium carbonate experiment. Again the simple statements "repeat" and "do a fair test" were seen. The first graph was well plotted and a suitable line of best fit drawn. Students tended to

be very superficial when they compared their data with that given. "My scale was different" is an example of this. Students need to practise comparing results in preparation for IAA's.

Unit 5014 (Additional Science – Physics)

P2 Topic 10: This was the only Additional Physics Series 4 IAA seen this time. There was some confusion about independent and dependent variables (see series 3 comments). All students were able to plot the extra data on the bar chart and spot the patterns. For the line graph many students chose to draw a straight line although the data does suggest a curve. This meant they were unable to discuss the patterns and draw conclusions in detail. Where students were asked to discuss Pauline's and Christine's improvements they tended to write the same answer twice rather than consider each persons point of view.

Administration

The annotation of scripts has improved since the summer although there are still a minority of centres who just tick. Centres which produced 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. 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. Other assessment and moderation difficulties included:-

- Centres making up their own mark schemes that were wholly inappropriate to the specification criteria,
- In cases where two mark bars were to be found in one skill area some Centres awarded only the highest mark – and so were making non-holistic judgements. It is imperative that 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 added lined paper for candidates to use when duplicating the IAAs – and as space on the papers is deliberately somewhat limited, this is an idea which deserves consideration by teachers and may depend to some extent upon the likely target cohort.

Some Centres apparently did not give students the opportunity to do the recommended practical work before commencing the IAAs, and in some Centres there were a number of computer simulations or teacher demonstrations used. Candidates 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. In some of those Centres which had not actually performed the practical work, for example in the speed of sound experiment, the method described in the plan was wholly impossible, given the apparatus described, yet it was described as actually being undertaken. These Centres awarded very high marks for a description that was invalid and patently unreliable.

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 candidates 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 candidates 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 The Summer 2010

The current set of IAAs (series 3) continues to be valid until May 2010.

The latest set of IAAs (series 4) was published in June 2009. This set is valid until May 2011.

Series 5 IAAs will be made available later on this academic year.

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 a list of relevant in-class practical work available for both series 3 and series 4 IAAS. Please see the 360 Science website.
- Teachers can continue to send in queries and questions via Edexcel's "Ask The Expert" e mail 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.

Grade Boundaries

Edexcel Devised Internal Assessment Units

Raw Mark Grade Boundaries

	Max mark	A*	A	B	C	D	E	F	G
5001									
5011									
5024	18	16	14	12	11	9	7	5	3
5034									
5044									

	Max mark	A*	A	B	C	D	E	F	G
5002									
5003									
5004									
5012	36	32	28	24	21	17	13	10	7
5013									
5014									

Uniform Mark Grade Boundaries - All Units

Max UMS	A*	A	B	C	D	E	F	G
40	36	32	28	24	20	16	12	8

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