GCSE

Applied Science Double Award

General Certificate of Secondary Education **J649**

Report on the Units

January 2009

J649/MS/R/09J

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This report on the Examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the syllabus content, of the operation of the scheme of assessment and of the application of assessment criteria.

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REPORTS ON THE UNITS

Chief Examiner's Report

General Comments
In the examinations, candidates were appropriately entered for the Foundation tier paper, with most showing knowledge across all question areas. At this level, candidates made good use of time, with very few part questions left unattempted. There was evidence to suggest, however, that a significant number of candidates were inappropriately prepared for the higher tier paper. In particular, many appeared unfamiliar with specification content required at this level.

It is expected that candidates on both tiers are able to give appropriate definitions or explanations of scientific terms in the specification. This continues to be a general weakness; Centres need to work on improving candidates' knowledge and understanding of 'key' words that define the most important learning objectives on the specification, and knowledge of chemical symbols and formulae cited in the appendices of the specification.

In the portfolio units, please ensure that OCR's URS form is completed for each candidate, with the Centre and each candidate's name and number. It would also assist in the moderation process if Centres recorded assessment information on OCR's recommended tracking grid, which can be found in the appendices of this document. Please present portfolio work in envelope folders or cut-flush files, or tied together using treasury tags.

Practical activities selected by many Centres were often in the true spirit of the course, being applied in nature and often excellent examples of work-related learning. For those Centres that are less sure in their development of practical activities, please refer to the appendices of this document, where a list of assignments illustrating best practice is provided.

A major issue in both portfolio units continues to be candidates' recording, display and processing of data. Candidates must **not** be awarded a Band 3 if key features such as correct table headings and units are missing, or there is no consideration of a use of significant figures in calculations. The attention of Centres needs also to be drawn to conclusions and evaluations at Bands 2 and 3. Note that in B481, *simple* scientific knowledge should be used to explain findings at Band 2 (detailed knowledge and understanding is required at Band 3). *All* candidates should attempt evaluations, and appropriate scientific terminology must be used to procure Band 3.

B481: Developing Scientific Skills (Portfolio)

General Comments
In this session, the majority of Centres is to be commended for the way in which this unit has been implemented and delivered. Administration has, on the whole, been efficient, though Centres must guard against arithmetical errors when calculating final marks for the units, and clerical errors in the transfer of these onto the OCR Interchange or MS1s.

Centres must also make careful checks on the way the assessment criteria are being translated into marks, and guidance on this from the specification is reproduced in Appendices II and III. Any Centres that might remain unsure of how to apply the assessment criteria accurately should seek further guidance from OCR.

In this session, many Centres had ensured that internal standardisation procedures had been carried out, and documentary evidence of this was supplied. In a minority, however, the lack of these procedures was evident in inconsistent marking between different teachers, and this is an important issue that has to be resolved.

For B481, it was apparent that Centres had ensured diligently that candidates had fulfilled the requirements of the assessment evidence grids, but it should also be noted that due consideration should be paid to appropriate coverage of the Assessment Objectives of the unit (Centres should refer to page 97 of the specification), and Performance Descriptions (pages 114 and 115). One important issue observed in write ups of standard procedures by higher ability candidates was that in many instances, only a limited attempt had been made to relate experimental findings to scientific principles (AO2).

The most successful implementation of the specification has been observed in Centres that have taken a holistic view of the course. The course rationale, highlighted in the specification, involves candidates obtaining and developing the necessary knowledge and understanding of science (Unit 2), developing and carrying out underpinning practical skills in Unit 1, and then *applying* practical skills and a knowledge and understanding of science in Unit 3. Several Centres have been seen to develop further themes initiated in previous sessions.

Centres should also take particular note of the presentation of candidates' portfolios. It would greatly assist the moderation process if candidates' portfolios were presented in cardboard wallets or cut-flush folders, or bound with treasury tags; please do not enclose portfolio material in plastic wallets.

Comments on activities chosen
Many Centres, in particular those who are becoming more experienced with Applied Science, have adopted a truly vocational approach, linking in with local industries and thereby enabling candidates to compare their methodologies with professional techniques.

Particularly successful has been the industrial involvement in the section on Working Safely in Science, with many Centres laying on visits or speakers and some giving candidates opportunities to undergo a range of general Health and Safety, Fire Safety and First Aid courses leading to certification. Candidates from some of these Centres have used very commendable, excellent photographic records to embellish their portfolios.
Practical activities seen were varied and usually enabled candidates' achievement at the appropriate level, but were not always applied in nature. The converse was also true; some of the Centres developing more innovative assignments had not always appreciated opportunities to stretch more able candidates or tailor tasks carefully to the assessment criteria.

Many instances were seen where several B481 activities were encompassed within a broader context. Particularly successful were those developed around a forensic science or brewing scenario. A more carefully chosen context, in many instances, would not only be more within the spirit of the course, but also be more conducive to candidates' achievement at all levels of ability.

For inexperienced Centres, whose approach does not yet have a truly applied feel, a list of suitable practical activities that have been implemented successfully is attached in Appendix I.

Comments on assessment

The vast majority of Centres is applying the assessment criteria appropriately. Some are not, however, apportioning marks to each skill area using the method recommended by OCR, while others are not recording these satisfactorily on the OCR marking grid. An increasing number of Centres has developed a spreadsheet for calculating marks, but Centres must ensure that these are calculating the marks accurately.

As indicated in the specification, in strands a, b and c, and in certain instances in other strands, e.g., the calculations in strand e, assessor annotation of candidate portfolios is essential in the endorsement of the mark band attained. It should be noted that a mark band should be clearly indicated on candidates' work in *each* of the strands b-e for *each* practical activity. Attachment to each portfolio of a completed OCR-recommended grid greatly speeds up the moderation process.

Some Centres are also sending to their moderator copies of the standard procedures assignments undertaken by their candidates. This greatly assists the moderator in judging the degree of guidance given to candidates. It is recommended that *all* Centres do this in future to help to facilitate the moderation process.

Centres encouraging candidates to improve the standard of their work in a single activity in Strands d and e, so as to obtain higher marks, must ensure that the necessary criteria, e.g., appropriate recording of data in Strand d, are addressed *unequivocally*. Centres' attention is also drawn, in particular, to the fact that candidates working towards a Band 3 score must now have a full complement of practical activities at a minimum of Band 1. Candidates working towards Band 3 should be recording and processing data and observations independently and writing conclusions and evaluations without the aid of writing frames or very prescriptive questioning.

A minority of Centres still continues to undertake more than the required number of practicals and also includes superfluous material and notes in candidate portfolios along with, in some instances, several drafts of assignment work. While the latter shows the evolution of the candidate's work, it is unnecessary and may impede the moderation process. Centres should only submit that work which is necessary for inclusion, clearly labelled as each of the designated areas for practical activities.

Strand a

A report on research into working safely in science, including hazards and risks, first aid and fire prevention

In this strand, many candidates' portfolios have been of a very high standard indeed. In some however, Centres have been very generous in their apportionment of marks.

Candidates are assessed on their use of information sources and the quality of the report.

To confirm the range of information sources used, candidates should compile a References' List. At Band 3, this should be written with appropriate detail according to an accepted convention. There should also be some justification as to why each source was used. If including images obtained from a website or textbook in their reports, many candidates are now acknowledging

their source, although a number of candidates are presenting photocopied material and material printed directly from the Internet in their portfolios. Centres need to appreciate that the latter is only appropriate for Band 1.

Candidates are also assessed on the quality of the report, which must contain textual and visual material at the appropriate level. Those working at Band 3 are expected to demonstrate an in-depth understanding of Health and Safety; arguably this is best demonstrated by the application of the principles of Health and Safety to new situations, for instance reviewing Health and Safety provision on workplace visits.

Strand b
Carry out Risk Assessments
It is recommended that Centres provide appropriate proformas for Risk Assessments and give guidance to the less able candidates so that *all* candidates should produce a workable Risk Assessment. The level of guidance given should then be indicated by teacher annotation. Caution should, however, be exercised in the use of some of the Risk Assessment proformas in published materials. Those listing potential hazards will necessarily limit candidate performance to Band 1.

Risk Assessments were frequently given too generous a mark by Centres. They were often too simplistic and generic; a common fault was to list many generic hazards and their associated risks.

Centres awarding Band 3 for a Risk Assessment should note that it should be 'full' and 'appropriate'. For a Risk Assessment to be full, candidates working at higher levels should not be omitting specific hazards to be considered, such as microscopical stains, reagents in qualitative tests, or an indicator in a titration. An 'appropriate' Risk Assessment refers, for instance, to an appropriate match between the concentration of a chemical used and its hazard and associated risk.

Strand c
Follow standard procedures involved in practical tasks using scientific equipment and materials
In some Centres, the confirmation of the competence of the candidate in the selection of equipment and the carrying out of each standard procedure was clearly indicated. Centres had used OCR's 'Certificate of Practical Skills' or simple annotation of candidates' portfolios. A very few Centres, however, are still giving just a single, overall mark of candidate performance, without designating how this is made up. This needs to be addressed by Centres so that moderators can endorse fully the Strand c mark awarded.

Centres should also pay due consideration to Strand d performance when assigning levels to practical competence. Some Centres are awarding high levels for Strand c, when data recorded do not support this, e.g., in titrations.

Strand d
Make observations and obtain and record measurements
Centres are, in general, assessing this strand accurately, though there are some anomalies. Candidates are assessed on the recording and display of observations and measurements, commenting on or carrying out repeats, and on appropriate calculations.

For candidates working at Band 3, all tables and graphs should be appropriately labelled, and units should be included. Data should be recorded to an appropriate and equivalent number of decimal places. For titration readings, for instance, volumes (ideally) should be recorded to the nearest 0.05 cm^3 (or 0.1 cm^3) and all data expressed to two (or one) decimal places. Writing frames should be used with caution. While blank tables and axes of graphs are appropriate for lower ability candidates, their use will preclude achievement of Band 3, and unless the data

recorded are particularly complex, e.g., the counts from cells of a haemacytometer, at Band 2 also. When awarding high levels for microscope diagrams, Centres should ensure that candidates are producing these accurately and also, not simply replicating textbook versions.

Graphs should also be drawn for practical activities *where they are appropriate*. Centres have acknowledged that this is not possible in all areas, but some are not looking sufficiently hard for opportunities. Teachers should also check carefully levels awarded to graphs. Some candidates, having confused the plotting of dependent and independent variables, or having omitted units, were nevertheless awarded Band 3 by Centre marking.

To achieve Bands 2 and 3, students must make appropriate calculations:

'Simple' calculations at Band 2 include means, percentages, magnifications (eyepiece x objective lenses) and simple substitution in equations, such as calculation of density.

Manipulating data at Band 3, includes calculations involving the rearrangement of equations (for instance, for titration calculations or V = IR for calculations of electrical resistance), scales on cell diagrams, dimensions of cells and other microscopical observations; cell counts using haemacytometers; calculations of the concentrations of solutions from titrations and the tensile strength of materials.

Centres should annotate candidates' work, indicating the formulae given to make their calculations. Note also that at Band 3, it is essential that candidates have an appreciation of the use of significant figures.

At Band 2, candidates should at least comment on the use of repeats, even if they do not think that they are required. At Band 3, candidates should carry out 'repeats' whenever it is practicable to do so. Should it not be practicable – for instance in destructive testing – class results could be pooled. This is, of course, the very purpose of carrying out standard procedures, so that data are comparable.

Strand e
Analyse and evaluate data
Some Centres are awarding marks too generously in this strand. All students should be encouraged to make, at the very least, rudimentary conclusions *and* evaluations to calculations where these are appropriate, to achieve a mark for this strand.

At Band 3, and to a lesser extent at Band 2, candidates should be relating their findings to relevant scientific knowledge and understanding in Unit 2, e.g., explaining, using particle models, why metals are better conductors of heat than polymers. Higher level candidates should also compare, where possible, their findings with those reported in the scientific literature, e.g., values of the densities of different materials.

For candidate evaluations, comments relating simply to how successful the standard procedure was are credited with no more than Band 1. At Band 3, candidates should comment on strengths and weaknesses of the procedure, and be using the terms, 'accuracy', 'precision', 'reliability' and 'sensitivity' when discussing equipment and reagents, along with practical difficulties associated with the procedure and sources of error introduced by themselves, but *not* those produced as a result of carelessness. Suggestions for improvements should be explained at this level.

Appendix I Practical activities undertaken

Microscopy

Preparing temporary slides of banana cells; onion cells
Preparing temporary slides of cheek cells
Examining prepared slides of plant and animal tissues
Yeast cell counts (using haemacytometers)
Comparing fibres
Forensic examination of hair

Microorganisms

Antiseptic and disinfectant sensitivity testing
Investigating the effects of antibiotics on *Escherichia coli* (could also extend to Unit 3)

Qualitative analysis

Identification of unknown salts
Forensic science investigations (testing for anions and cations)
Chromatography of ink

Quantitative analysis

The concentration of ethanoic acid in vinegar
Determining the concentration of citric acid in carbonated drinks

Electrical properties

Determining the resistance of a wire (material used, length, diameter)
Testing wires for their suitability as a heating element
Testing wires for their suitability as electrical cables

Other physical properties

Properties of food packaging materials
Properties of polymers labelled as biodegradable
Properties of insulating materials
The thermal conductivity of materials
Investigating the properties (compressive strength, porosity, density) of mortar made to different specifications

Appendix II Awarding of marks

Unit 1: Awarding of Marks

Strand a:

Working Safely in Science (12 marks)

A report on research into working safely in science including:

- Hazards and Risks
- First Aid
- Fire Prevention

Marks should be awarded as follows:

Band 3:	12 marks for **three** areas at band 3
10-12 marks	11 marks for **two** areas at band 3; the other areas at least band 1
	10 marks for **one** area at band 3; the other areas at least band 1
Band 2:	9 marks for **three** areas at band 2
7-9 marks	8 marks for **two** areas at least band 2
	7 marks for **one** area at least band 2
Band 1:	6 marks for **three** areas at band 1
0-6 marks	3, 4, 5 marks for **two** areas at band 1
	1 or 2 marks for **one** area at band 1

Laboratory notebook

A candidate's laboratory notebook needs to include records of six practical activities – one in each of the following:

- Microscopy
- Culturing organisms
- Qualitative analysis
- Quantitative analysis
- Electrical properties
- Other physical properties

In each strand, for each activity, marks should be awarded as follows:

Strand b:	
Produce Risk Assessments (6 marks)	
Band 3:	6 marks for **six** completed risk assessments at band 3
5-6 marks	5 marks for **four or five** completed risk assessments at band 3; one at least band 1
Band 2:	4 marks for **six** completed risk assessments at, at least band 2
3-4 marks	3 marks for **three, four or five** completed risk assessments at, at least band 2
Band 1:	2 marks for **six** completed risk assessments at, at least band 1
0-6 marks	1 mark for **two, three, four or five** completed risk assessments at, at least band 1

Strand c:	
Follow standard procedures involved in practical tasks using scientific equipment and materials (8 marks)	
Band 3:	8 marks for **six** completed activities at band 3
7-8marks	7 marks for **four or five** completed activities at band 3
Band 2:	6 marks for **five or six** completed activities at, at least band 2
4-6 marks	5 marks for **four** completed activities at, at least band 2
	4 marks for **three** completed activities at, at least band 2
Band 1:	3 marks for **five or six** completed activities at, at least band 1
0-3 marks	2 marks for **three or four** completed activities at, at least band 1
	1 mark for **one or two** completed activities at, at least band 1

Strand d:	
Make and record observations and / or measurements, present and process data (12 marks)	
Band 3:	12 marks for **six** completed activities at band 3
9-12marks	11 marks for **five** completed activities at band 3; the other activity at least band 1
	10 marks for **three or four** completed activities at band 3; the other activities at least band 1
	9 marks for **one or two** completed activities at band 3; the other activities at least band 1
Band 2:	8 marks for **five or six** completed activities at band 2
6-8 marks	7 marks for **three or four** completed activities at band 2
	6 marks for **one or two** completed activities at band 2
Band 1:	5 marks for **six** completed activities at band 1
0-5 marks	4 marks for **five** completed activities at band 1
	3 marks for **three or four** completed activities at band 1
	2 marks for **two** completed activities at band 1
	1 mark for **one** completed activity at band 1

Strand e:	
Draw conclusions and evaluate data (12 marks)	
Band 3:	12 marks for **six** completed activities at band 3
8-12 marks	11 marks for **five** completed activities at band 3; the other activity at least band 1
	10 marks for **three or four** completed activities at band 3; the other activities at least band 1
	9 marks for **two** completed activities at band 3; the other activities at least band 1
	8 marks for **one** completed activity at band 3; the other activities at least band 1
Band 2:	7 marks for **five or six** completed activities at band 2
5-7 marks	6 marks for **three or four** completed activities at band 2
	5 marks for **one or two** completed activities at band 2
Band 1:	4 marks for **six** completed activities at band 1
0-4 marks	3 marks for **five** completed activities at band 1
	2 marks for **three or four** completed activities at band 1
	1 mark for **one or two** completed activities at band 1

Appendix III Recording of marks

Candidate					
Developing scientific skills					
	a	**b**	**c**	**d**	**e**
	Working safely in science	**Risk assessment**	**Follow procedure**	**Record display process data**	**Conclusion and evaluation**
Hazards and risks					
First Aid					
Fire Prevention					
Microscopy					
Culturing organisms					
Qualitative analysis					
Quantitative analysis					
Electrical properties					
Physical properties					
Mark for strand					
TOTAL for unit					

B482/01: Applied Science: Double Award, Foundation Tier

General Comments
The foundation tier paper is designed to test the knowledge and skills of candidates performing at grades GG to CC. Candidates were appropriately entered for this tier paper. Candidates made good use of time, with very few part questions left unattempted.

Teacher's tip:
Candidates aiming at a grade CC should be entered for the foundation tier paper where they will be able to show what they know and can do. The higher tier paper is designed to differentiate between the higher grades.

It is important that candidates learn the list of element symbols and formulae given in Appendix D of the specification.

The standard of responses was not quite as strong as in previous sessions. Commonly, this was because candidates did not know basic, important factual information such as how to set up a fermentation. Other important factual information from the specification objectives that was not known included Steel Reinforced Concrete, names of the three essential plant elements, conditions for fermentation, and diabetes. This lack of factual recall meant that marks for the easier questions earlier in the paper were not as high as seen in previous sessions.

Comments on Individual Questions

1 This question was an introductory question and, along with the other earlier questions on the paper, was designed to test achievement between grades GG and EE. In common with most applied science questions, the candidates were given a stem of information to read before addressing the question. This question asked about composites in the context of Steel Reinforced Concrete (SRC). Many candidates did not seem to know anything about SRC, even though it is clearly mentioned in the specification.

a Most gained one of the two available marks for saying that SRC is 'stronger'.

Teacher's tip:
Practise two-mark questions with candidates – many of them only make a single point and so can only score (1) of the available (2) marks.

b Most correctly classified steel as a metal but could not classify either of the two other materials correctly.

Teacher's tip:
Classifying materials as belonging to one of the four main classes of material mentioned in the specification (metal, ceramic, composite and polymer) is a common examination task – practise this with candidates.

c Most answered this well and gained at least two of the three available marks. Most correctly link rust formation on older bridges to the orange stains, and knew that rusty steel was weaker and more likely to break. In (iii), candidates used the information in the table well to discuss the poor electrical conductivity of rust. Handling tabulated information was a strength of the candidates.

2 This question was also aimed at lower demand.

a Very few candidates could identify both of the essential elements, nitrogen and phosphorus, from the list.

> **Teacher's tip:**
> It is very important that students learn the main factual information in the specification. For foundation tier (the first two columns), there is not a large amount; some schools target the learning of important facts using games and matching exercises in the run up to the examination.

b Many candidates did not score here owing to poor wording of their answers. 'Fertilisers make plants grow' was not given credit – the examiners looked for faster or 'more' growth. Very few knew that a major disadvantage of using fertiliser was its run off into watercourses.

c Most candidates suggested 'natural' fertiliser, which was not given a mark, rather than 'organic' or 'manure'.

d Surprisingly few candidates knew the conditions for fermentation. Most suggested 'adding alcohol'! Few suggested increasing the temperature to speed up the process in (ii).

3 a The interpretation of flow charts was not well done. Many candidates suggested 'sulfur dioxide' as a raw material.

b Few were able to explain what 'bulk' chemical meant. Most knew that it implies a 'large amount' but did not link this to the process of *production*. Answers such as '*made* in large amounts' or 'large scale' were awarded a mark.

c The formula of sulfuric acid was not well known. It is important that the formulae in Appendix D of the specification are known by candidates. At foundation tier, only the most common ones are usually tested using recognition tasks.

> **Teacher's tip:**
> Use matching games, blockbusters, dominoes or bingo games to make sure that foundation tier candidates can recognise the formulae from Appendix D.

d This was well answered; most recognised oxidation.

e In (i), most gained at least one mark, but few knew both main functions of catalysts.

In (ii), few were able to suggest two ways of increasing rate. 'Add more substances' was a common incorrect answer.

f Very few could classify the three substances as an element, mixture or compound. Very few knew that air is a mixture! Some candidates used curved, rather than straight lines to join boxes. This sometimes makes it difficult to tell which box the line goes to.

Teacher's tip:
Classifying substances as elements, compounds and mixtures is a common assessment task – it is another skill worth practising regularly.

4 This question was the last of the lower demand questions on the paper. Many of the tasks in this question were recognition and matching tasks. Candidates performed well.

a Most correctly identified the important features of a nuclear fuel.

b In this question, candidates confused types of energy with types of energy *sources*. Thus, common incorrect responses included giving sources such as 'wind' 'tidal' and so on. In (ii) marks were lost by candidates who gave vague responses such as 'quicker' 'easier' – such vague words rarely gain marks on a science paper. Better answers discussed the range of sources that could be used to generate electricity, the fact that it does not need to be stored and that it can be transported to houses easily.

Teacher's tip:
Warn candidates about using vague words – mark schemes are usually based on making clear, scientific points so 'easier; 'cheaper' and 'quicker' are not usually given any credit.

c Surprisingly few candidates got this fully correct. Many gave 'biofuel' as a fossil fuel, and the majority thought that 'natural gas' was a renewable energy source.

5 This question was an 'overlap' question which also appeared on the higher tier paper. It was designed to test achievement at CC and DD grades. As such, it was difficult for many foundation tier candidates. Very few scored more than half marks.

a Many candidates confused insulin with sugar as the substance that diabetics test in their blood. However, most used the information given in the question very well to discuss advantages of the new device. Answers such as 'always gives the correct dose' and 'people no longer need to inject themselves' were commonly seen, leading to the award of two marks for many candidates.

Teacher's tip:
Practise questions with candidates where information is given in the stem of the question. Good use of that information in this question scored an easy two marks on one that was quite difficult.

b The organ that produces insulin (pancreas) and the means of its transport (in blood plasma) was not recognised by foundation tier candidates. However, most made a guess, so few gaps were seen here.
Similarly, in (iii) few knew why hormonal changes are slower acting than nerve impulses.

c Vague and incorrect understanding of control of diabetes cost marks in this part question. Many candidates suggested a diet change, but were confused over what that should be. 'Eat more sugar' was commonly seen. Similarly 'have a biscuit' type answers were also given. Many thought insulin could be given in tablet form.

6 The last question on the paper was also targeted at grades DD to CC. The recognition-type tasks meant that most candidates 'had a go' so many scored almost half marks. This area of the specification is relatively new, but most showed knowledge of the new material.

a Most knew that plates are called 'tectonic'.

b Most knew that earthquakes happen on plate boundaries. Candidates should be aware, however, that the centre of the cross is always taken as the 'point' when crosses are used to annotate diagrams. Sloppy crosses with their centres 'off the line' were marked as incorrect.

The method of measurement of movement was less well known. Most talked vaguely about 'measuring how far apart the plates are' but did not suggest a method for doing so. Some gained a mark for realising that measurements would have to be taken at several points over time to detect movement.

c Candidates did not generally know what happens at plate boundaries. Few gained both marks here.

d Surprisingly few gave both correct answers for the changes that occur at plate boundaries. 'Melting icecaps' and 'mountain erosion' were commonly chosen incorrectly. In (ii), most correctly stated that plates are moving apart but fewer discussed the fact that the continents are carried *on* the plates and so move with them.

B482/02: Applied Science: Double Award, Higher Tier

General Comments
The Higher tier paper is designed to test the knowledge and skills of candidates performing at grades CC to A*A*. There was evidence to suggest that a significant number of candidates were inappropriately prepared for the higher tier paper. In particular, many appeared unfamiliar with specification content specifically identified as higher tier. Candidates made good use of time with very few part questions left blank. Candidates being prepared for the higher tier need to be familiar with the higher tier content.

Teacher's tip:
Students aiming at a grade CC should be entered for the foundation tier paper, where they will be able to show what they know and can do. The higher tier paper is designed to differentiate between higher grades and many of the questions require knowledge specific to the higher tier and many questions require candidates to analyse and present answers at a much higher level than on the foundation paper.

It is expected that candidates on the higher tier are able to give appropriate definitions or explanations of scientific terms in the specification. This was a general weakness with very few being able to give more than a vague suggestion of the meaning of words such as 'insulation' and 'homeostasis'.

It was clear that a significant minority of candidates did not have calculators and these candidates were at a disadvantage. Calculators are required items for the exam and questions are set with the assumption that a candidate has a calculator.

Comments on Individual Questions

1 The first question on the paper was targeted at grades C and D. This area of the specification is relatively new, but most showed knowledge of the new material.

a Most knew that plates are called 'tectonic'.

b Most knew that earthquakes happen on plate boundaries. The method of measurement of movement was less well known, although specifically stated in the specification. The most commonly scored mark was for realising measurements would have to be taken at several points over time to detect movement. By far the most common error was 'the seismograph'.

c This was poorly answered. In (i), surprisingly few knew about the formation of new rocks at mid-ocean ridges. More identified that plates moving in the same direction generated fewest earthquakes in (ii).

d Most correctly ticked 'mountain formation and volcanoes' for the changes that occur at plate boundaries. The most common errors were 'melting icecaps' and 'mountain erosion'. In (ii), most correctly identified that the plates are moving apart but fewer made it clear that the continents are carried *on* the plates and so move with them.

2 This question was an 'overlap' question, which also appeared on the foundation tier paper. It was designed to test achievement at C and D grades. As such, it should be straightforward for higher foundation tier candidates. Many candidates scored more than half marks.

a This was generally well answered. A few candidates confused insulin with sugar as the substance that diabetics test in their blood. However, most used the information given in the question very well to discuss advantages of the new device.

b The organ that produces insulin (pancreas) was usually correct, although few knew that it was transported in blood plasma. The most common error was the 'red blood cell'. In (iii), many knew why hormonal changes are slower acting than nerve impulses.

c Most candidates suggested a diet change, but were confused over what that should be. 'Eat more sugar' was commonly seen. Exercise was given as a second method by less than half the candidates.

3 This question and subsequent questions are solely for higher tier and are mostly targeted at grades B, A and A*.

a Most candidates scored both marks on this straightforward opening part.

b A pleasing number of candidates knew that a covalent bond involved shared electrons. Common errors were the idea of shared atoms and the confusion with ionic bonding common.

c Few candidates were able to equate the spaghetti of the model to the long polymer molecules. In (ii), almost no candidates mentioned the role of cross-linking when discussing the differences in properties of thermoplastic and thermosetting polymers. Most marks were gained for the sliding of polymers past each other in thermoplastics.

d Metallic bonding and ideas about electrical conduction were very poorly understood, with many candidates thinking that metallic bonding was the alloying of two different metals. The most common electrical misconception was that atoms being closely packed meant that they could pass electricity to each other. Some excellent answers in terms of seas of electrons and free electrons were, however, seen.

Teacher's tip:
Bonding is a key scientific idea. The specification requires knowledge of covalent, ionic and metallic bonding. Candidates should be able to explain each of these with words and appropriate diagrams.

4 a Many of the answers here were either too vague, e.g., 'cause pollution,' or failed to deal specifically with nuclear fuels, e.g., 'power station is an eyesore'. Better answers referred to radioactive waste or small amounts of fuel.

b Candidates clearly have difficulty distinguishing between recycling and renewable. The most common error was 'cannot be used again'.

> **Teacher's tip:**
> Use this question to practise writing a clear explanation of renewable and non-renewable resources.

c The National Grid was very badly understood. Almost no candidates described the network nature of the National Grid, in which many power stations are connected to many users, or referred to the use of transformers to provide different voltages for transmission and supply. A mark was allowed for a physical description for example of cables and pylons. An occasional error was to describe the process in a power station generating electricity.

d More candidates were able to complete the calculation correctly than knew the formula for power, voltage and current. As usual, the 'triangle' mathematical aid was not credited as the formula. The need to re-arrange the equation raised the difficulty of the question. Weaker candidates often left this part blank.

e Few candidates gained all three marks for the Sankey diagram. Most commonly lost marks were for incorrect labelling, in particular of the electrical energy out. Many also failed to consider the proportions of electrical and waste energy given in the question. Few could calculate the efficiency, but there was no clear pattern of misunderstanding.

> **Teacher's tip:**
> Higher tier candidates are expected to be able to carry out simple calculations. There are few formulae that they are expected to know so only a limited number of calculations are possible. Use past question papers to practise these calculations.

5 a This required simple recall of the role of some nutrient minerals for plants. Few gained full marks. The most commonly correct answer was phosphate for root growth. Potassium was a common error for the element required to make chlorophyll.

b Most knew that mitosis was involved in plant growth and most who knew this could state that two cells were formed. The most common errors were meiosis, and imaginative spellings which could not be identified as mitosis.

c A pleasing number of candidates scored full marks for the equation. Unfortunately many candidates could not correctly write down the formula for water, carbon dioxide and oxygen e.g. CO2, Co_2, cO_2 and CO^2. At higher tier, candidates are expected both to remember symbol formulae and write them correctly.

d Almost no candidates knew that solubility is the reason starch is used for storage rather than glucose.

6 a This was a straightforward start to the final question. Nearly all candidates correctly identified elements and compounds. However, far fewer identified air as the mixture, with the most common error being sulfuric acid.

b Many candidates identified oxygen as the missing reactant, but then just wrote O instead of O_2.
In (ii), very few knew the reaction was an oxidation reaction, with many candidates simply leaving this blank.

Candidates often lost a mark here for poor expression. At this level, candidates are expected to refer to the **rate** of effective collisions and not simply to 'more collisions,' which was a very common error. Most picked up a mark for identifying that the rate of reaction increased.

Teacher's tip:
Use this question to practise writing clear explanations about how changes to collision **rate** and **energy** affect rates of reaction.

c Fewer than half the candidates correctly identified dyes as the fine chemical. The most common error was fertilisers.

B483: Science at Work (Portfolio)

General Comments
In this session, the majority of Centres is to be commended for the way in which this unit has been implemented and delivered. Administration has, on the whole, been efficient, though Centres must guard against arithmetical errors when calculating final marks for the units, and clerical errors in the transfer of these onto the OCR Interchange or MS1s.

Centres must also make careful checks on the way the assessment criteria are being translated into marks; this was particularly apparent in this unit. It is also recommended that mark bands for each criterion, for each strand, are also recorded carefully for the benefit of the moderator. Guidance on this, from the specification, is reproduced in Appendices II and III. Any Centres that might remain unsure of how to apply the assessment criteria accurately should seek further guidance from OCR.

In this session, many Centres had ensured that internal standardisation procedures had been carried out, and documentary evidence of this was supplied. In a minority, however, the lack of these procedures was evident in inconsistent marking between different teachers, and this is an important issue that has to be resolved.

For B483, it was again apparent that Centres had ensured diligently that candidates had fulfilled the requirements of the assessment evidence grids, but it should also be noted that due consideration should be paid to appropriate coverage of the Assessment Objectives of the unit (Centres should refer to page 97 of the specification), and Performance Descriptions (pages 114 and 115). One important issue observed in write ups of standard procedures by higher ability candidates was that in many instances, only a limited attempt had been made to relate experimental findings to scientific principles (AO2).

For practical activities, Centres should also ensure that candidates working at higher levels use good scientific practice and ensure that data are recorded appropriately. Tables, for instance, must be correctly labelled and include units, and candidates should have an appreciation of the use of significant figures. Conclusions at higher levels must relate findings to background science and evaluations must use appropriate scientific terminology. Centres' attention is also drawn, in particular, to the fact that candidates working towards a Band 3 score must now have a full complement of practical activities at a minimum of Band 2.

Centres should also take particular note of the presentation of candidates' portfolios. It would greatly assist the moderation process if candidates' portfolios were presented in cardboard wallets or cut-flush folders, or bound with treasury tags; please do not enclose portfolio material in plastic wallets.

Strand a
A report on how science is used in the workplace

Some good work was seen, but there still tends to be an over-reliance on corporate websites, as often the sole information source. While websites such as http://www.learndirect-advice.co.uk/ and http://www.connexions-direct.com often give an excellent introduction to careers, and information on qualifications required for those careers, they should be used as stimulus material, and not the principal reference. Higher scoring candidates should also be explaining the significance of these qualifications and skills. It was noted in this session that Centres with excellent links with the world of work did not exploit these to the full.

Note that after the initial overview of science in the workplace at Band 1, candidates should then study **two** organisations in detail. Attention is drawn to the hierarchy among the criteria;

candidates are often identifying at Band 1, describing at Band 2, and giving explanations at Band 3. An *explanation* of the importance of the work carried out by an organisation is often easier when supported by statistical data.

More emphasis should also be placed on investigating the *science* used by these workplaces, particularly in candidates working towards higher levels. Some candidates had researched very carefully scientific reasons for the sitting of industries, and are realising the implications of this in working with other subject areas. Note that there is no requirement to address *all* reasons cited for the location of an organisation, i.e., scientific, economic, social and environmental, for *both* of those studied.

Strand b
The production of pure, dry samples from two types of chemical reaction

This strand has been well-covered, with candidates in all Centres carrying out appropriate chemical reactions.

For criterion 1, the type of reaction was often not mentioned at all, however, and the level of science required when discussing the chemical reaction involved was sometimes underestimated at Bands 2 and 3. Centres should annotate portfolios to indicate that a symbol equation has been balanced by the candidate, or evidence should be presented that demonstrate that the candidate has a clear understanding of how to balance the equation.

A key feature of portfolios of candidates working towards higher levels is that reports should be carefully produced, and not contain simple errors, such as the confusion of lower and upper case, and subscript and superscript in chemical formulae. It is also essential that higher scoring candidates should not use very prescriptive writing frames.

Evaluations were often too simplistic to be awarded Band 3.

Many Centres have found criterion six – a review of the energy inputs and the treatment of wastes in the industrial version of the process - difficult to address, but some have now found appropriate information sources.

Strand c
A report on the assembly and assessment of the effectiveness of one electronic or optical device

In this strand, Centres should ensure that discussions of the use of electronic devices and components are not too superficial, and note that *explanations* of why these components are used should be given at Band 3. Candidates should also review a wider series of components than just those used in their device.

Assessing the performance of electronic circuits, at Bands 2 and 3, should ideally include the collection of numerical data, and Centres should ensure that evaluations are carried out to a level appropriate to the ability of their candidates. For electronic devices, the best activities tended to involve the construction of potential divider circuits, which also enabled candidates to discuss the scientific principles involved. Some excellent work was seen involving the construction of telescopes.

Strand d
A report on mechanical devices

In this strand, Centres should ensure that all units are included in tables for candidates working at higher levels.

It should also be noted that for candidates to achieve the full six marks, there is a requirement to investigate the performance of a second, commercial device. Although this is ideally carried out on a practical basis, it could be done using secondary data. Candidates working at Band 3 are expected to evaluate the performance of the devices as well as making efficiency calculations.

Strand d
A report on monitoring the growth/development/response of an organism

In this strand, Centres had chosen an interesting range of organisms to monitor. Candidates in many Centres sometimes neglect their discussions of the reasons for monitoring the organism. Centres should also ensure that candidates working at higher levels display data appropriately and relate their findings to scientific principles. Discussions should, however, be fully integrated into their conclusions; often much physiological information is included simply as a 'bolt-on'. The calculation of growth rates is often a way of addressing criterion four at Band 3, though come Centres, commendably, are introducing statistics into their analyses of data at this level.

Evaluations were usually marked generously.

Appendix I Practical activities undertaken

The production of pure, dry samples from three types of chemical reaction

Redox:	displacement of copper from copper sulfate
	preparation of copper from malachite/copper oxide
Neutralisation:	preparation of potassium nitrate
	preparation of ammonium sulfate/nitrate
Precipitation:	preparation of lead chromate
	preparation of zinc carbonate/hydroxide
	preparation of silver halides
	preparation of barium sulfate
Esterification:	preparation of esters

A report on the assembly and assessment of the effectiveness of one electronic or optical device

Simple potential divider circuits
Monitoring light and temperature in a greenhouse
A night light
Making a transparency meter

A report on mechanical devices

Investigating levers, pulleys and gears
Investigating gym equipment
Investigating the car jack

A report on monitoring the growth/development/response of an organism

Monitoring yeast growth (in bread and alcoholic drinks)
Monitoring human performance
Monitoring the growth of cress seedlings
Monitoring the growth of mould
Monitoring the behaviour of primates
Monitoring the germination of seeds

Appendix II Awarding of marks

Unit 3: Awarding of Marks

In each strand, marks should be awarded as follows:

Strand a:	
A report on how science is used in the workplace (11 marks)	
Band 3:	11 marks for **five** criteria at band 3
9-11 marks	10 marks for **four** criteria at band 3; the **other** criterion completed at band 2
	9 marks for **two or three** criteria at band 3; the **other** criteria completed at band 2
Band 2:	8 marks for **five** criteria at, at least band 2
6-8marks	7 marks for **four** criteria at, at least band 2
	6 marks for **two** or **three** criteria at, at least band 2
Band 1:	5 marks for **six** criteria at, at least band 1
0-5 marks	4 marks for **five** criteria at, at least band 1
	3 marks for **four** criteria at, at least band 1
	2 marks for **two or three** criteria at, at least band 1
	1 mark for **one** criterion at band 1

Strand b:	
The production of pure, dry samples from two types of chemical reaction (13 marks)	
Band 3:	13 marks for **six** criteria at band 3
10-13 marks	12 marks for **five** criteria at band 3; the **other** criterion completed at band 2
	11 marks for **three or four** criteria at band 3; the **other** criteria completed at band 2
	10 marks for **one or two** criteria at band 3; the **other** criteria completed at band 2
Band 2:	9 marks for **six** criteria at least band 2
6-9 marks	8 marks for **five** criteria at least band 2; the **other** criterion completed at band 1
	7 marks for **three** or **four** criteria at least band 2; the **other** criteria completed at band 1
	6 marks for **one** or **two** criteria at least band 2; the **other** criteria completed at band 1

Band 1:	5 marks for **six** criteria at band 1
0-5 marks	4 marks for **five** criteria at band 1
	3 marks for **four** criteria at band 1
	2 marks for **three** criteria at band 1
	1 mark for **one or two** criteria at band 1

Strand c:

A report on the assembly and assessment of the effectiveness of one electronic/or electrical or optical device (7 marks)

Band 3:	7 marks for **three** criteria at band 3
6-7 marks	6 marks for **one or two** criteria at band 3; the **other** criteria/criterion completed at band 2
Band 2:	5 marks for **three** criteria at band 2
3-5 marks	4marks for **two** criteria at band 2; the **other** criterion completed at band 1
	3 marks for **one** criterion at band 2; the **other** criteria completed to band 1
Band 1:	2 marks for **three** criteria at band 1
1-2 marks	1 mark for **one or two** criteria at band 1

Strand d:

A report on mechanical devices (6 marks)

Band 3:	6 marks for **three** criteria at band 3
5-6 marks	5 marks for **one or two** criteria at band 3; the **other** criterion/criteria completed at band 2
Band 2:	4 marks for **three** criteria at band 2
3-4 marks	3 marks for **one or two** criteria at band 2; the **other** criteria/criterion completed at band 1
Band 1:	2 marks for **three** criteria at band 1
1-2 marks	1 mark for **one or two** criteria at band 1

Strand e:	
A report on monitoring the growth/development/response of an organism	
Band 3:	13 marks for **six** criteria at band 3
9-13 marks	12 marks for **five** criteria at band 3; the **other** criterion completed at band 2
	11 marks for **four** criteria at band 3; the **other** criteria completed at band 2
	10 marks for **three** criteria at band 3; the **other** criteria completed at band 2
	9 marks for **one or two** criteria at band 3; the **other** criteria completed at band 2
Band 2:	8 marks for **six** criteria at band 2
5-8 marks	7 marks for **five** criteria at band 2; the **other** criterion completed at band 1
	6 marks for **three or four** criteria at band 2; the **other** criteria completed at band 1
	5 marks for **one or two** criteria at band 2; the **other** criteria completed at band 1
Band 1:	4 marks for **five or six** criteria at band 1
0-4 marks	3 marks for **four** criteria at band 1
	2 marks for **three** criteria at band 1
	1 mark for **one or two** criteria at band 1

Appendix III Recording of marks

Unit 3: Science at work	**Centre:**
Candidate:	

Strand a

Science in the workplace

Criterion		Mark Band
1	Identify careers	
2	Work carried out by organisation	
3	Location of organisation	
4	Job titles and qualifications	
5	Use of science	
6	Quality of report	
Total		

Strand b

Chemical reactions

Criterion		Reaction		Mark Band
		1	2	
1	Type or reaction			
2	Products/reactants/equation			
3	Obtain product			
4	Calculation of yields			
5	Evaluation			
6	Energy input/waste disposal			
Total				

Strand c

Electronic/optical device

Criterion		Mark Band
1	Uses of electronic/optical devices	
2	Assemble device	
3	Evaluate device	
Total		

Strand d

Mechanical device

Criterion		Mark Band
1	Types of mechanical devices and components	
2	Assemble/ investigate performance	
3	Calculations of performance	
Total		

Strand e

Monitoring an organism

Criterion		Mark Band
1	Identify organism	
2	Produce plan/ monitor organism	
3	Record measurements/ observations	
4	Present and process data	
5	Explain findings	
6	Evaluate monitoring process	
Total		

Total for unit:

Grade Thresholds

General Certificate of Secondary Education
Applied Science (Double Award) J649

January 2009 Assessment Series

Unit Threshold Marks

Unit		Maximum Mark	A*	A	B	C	D	E	F	G	U
B481	Raw	50	46	42	38	35	28	22	16	10	0
	UMS	100	90	80	70	60	50	40	30	20	0
B482/1	Raw	60				34	28	22	17	12	0
	UMS	100				60	50	40	30	20	0
B482/2	Raw	60	45	37	29	21	14	10			0
	UMS	100	90	80	70	60	50	45			0
B483	Raw	50	46	42	38	35	28	22	16	10	0
	UMS	100	90	80	70	60	50	40	30	20	0

Entry Information

Unit	Total Entry
B481	3596
B482/1	6007
B482/2	1136
B483	345

Specification Aggregation Results

	A*A*	A*A	AA	AB	BB	BC	CC	CD	DD	DE	EE	EF	FF	FG	GG
UMS	270	255	240	225	210	195	180	165	150	135	120	105	90	75	60
Cum %	0.0	0.0	0.0	0.0	0.0	5.6	38.9	88.9	88.9	94.4	94.4	94.4	94.4	100.0	100.0

179 candidates were entered for aggregation this series.

For a description of how UMS marks are calculated see;
http://www.ocr.org.uk/exam_system/understand_ums.html

Statistics are correct at the time of publication.

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