OCR
RECOGNISING ACHIEVEMENT

GCSE

Applied Science (Double Award)

General Certificate of Secondary Education **J649**

Examiners' Reports

January 2011

J649/R/11J

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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 specification content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the Examination.

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Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

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General Certificate of Secondary Education

Applied Science (Double Award) (J649)

EXAMINERS' REPORTS

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, and notably, very few part questions were left unattempted.

In some questions, for instance, that on the wave power generator, candidates struggled to apply their knowledge and understanding to new situations. Knowledge was often lacking in candidates on the composition of gases in the air, atomic structure and genetic engineering. Candidates should also be reminded to read and assimilate information provided in the question before proceeding to complete the answers.

For the higher tier, 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 required at this level. Many able candidates were clearly making educated guesses in some questions, without the scientific knowledge that would have helped. Common errors were often made when giving definitions of, or using scientific terms such as, 'organic/inorganic', 'genetic engineering', 'aerobic/anaerobic' and 'renewable'. Please note also that many questions require candidates to analyse and present answers at a much higher level than on the foundation paper. Chemical equations contained many errors this session.

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, and *not* in plastic wallets.

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. In B483, please note that all criteria must be completed for candidates to be awarded a Band 3 mark.

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, and fewer arithmetical errors and clerical errors were noted when Centres calculated their final marks for the units.

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.

Though marking was largely consistent in this session, little documentary evidence of internal standardisation was supplied.

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. A few Centres are still using activities from the 2002 Teacher Guidance materials, and it is suggested that these now look to take a different approach and attempt to use activities that are more innovative. Please see the appendices, and consult OCR for further guidance if necessary.

Particularly successful has been the industrial involvement in the section on Working Safely in Science, with a number of 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.

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.

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.

It was of note this session that few centres supplied copies of assignments undertaken to their moderator, though this was often compensated for by information provided in a covering letter. Note that the provision of copies of the assignments 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.

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
Examination of stomata

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
Investigating the viscosity of different oils

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: **9-12marks**	12 marks for **six** completed activities at band 3
	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: **6-8 marks**	8 marks for **five or six** completed activities at band 2
	7 marks for **three or four** completed activities at band 2
	6 marks for **one or two** completed activities at band 2
Band 1: **0-5 marks**	5 marks for **six** completed activities at band 1
	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: **8-12 marks**	12 marks for **six** completed activities at band 3
	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: **5-7 marks**	7 marks for **five or six** completed activities at band 2
	6 marks for **three or four** completed activities at band 2
	5 marks for **one or two** completed activities at band 2
Band 1: **0-4 marks**	4 marks for **six** completed activities at band 1
	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. In this session, candidates were appropriately entered for the foundation tier paper; most showed knowledge across all question areas. Candidates made good use of time and very few part questions were 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 higher grades.

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.

a) Most candidates identified the important properties in i) and ii) without a problem, although some thought that the flammability would be an issue when using cling film to wrap food. Many candidates only gave a single reason in (iii) and so only scored a single mark.

b) The commonest reason for failing to score here, was that candidates did not discuss the structure of the two polymers clearly. 'They both have C in them' or 'they both have H's' was not enough to earn a mark. It was important that candidates showed that they knew that the C and H represented atoms or elements in the molecules.

c) Most identified the strongest polymer, but then did not go on to give a full explanation for using polymer B as a replacement in (ii). Many realised that amount of stretch was important, but few gave any further detail to score the second mark.

2 This question produced higher scores than the first question, implying that candidates have a good understanding of the health effects of smoking.

a) Some candidates confused passive smoking with chain smoking, but most gave at least a partially correct answer showing that they understood that passive smoking affects non-smokers.

b) Most knew the correct average body temperature.

c) Almost every candidate scored at least a single mark for labelling the diagram. The commonest confusion was between the trachea and the diaphragm.

d) Most knew that respiration uses oxygen, but many chose 'water' as the second substance needed, rather than glucose. Most gave at least a partial explanation of the benefits of exercise on either the heart or blood circulation, but some merely restated the question, saying for example 'the substances move around faster'.

3 Candidates found this question difficult. The question tested their ability to work in an unfamiliar context. Many candidates did not assimilate the information they were given at the start of the question.

a) Candidates were told that the energy was 'wave' and 'electrical' in the question and most managed to insert these the right way round on the diagram. Some more able candidates used the correct term 'kinetic' in place of 'wave'. The calculation proved more difficult, but all candidates 'had a go', many choosing to subtract or divide the two values rather than to correctly add them together.

b) Vague answers cost marks here. Similar questions have been asked on previous papers. Common vague responses were 'it is quicker' or 'it is easy to use'. Incorrect responses included 'cheaper' or 'it is renewable'. Better answers discussed the versatility of electricity e.g. in being able to power many different appliances. Some correctly discussed the benefits of the national grid or the lack of any need for storage.

c) Most scored an easy three marks for identifying the meaning and examples of renewable energy sources.

4 This question was the last of the lower demand questions on the paper. Candidates scored well when asked to interpret the table, but fewer knew the gases in the air or the difference between inhaled and exhaled air.

a) Almost all candidates gained at least one mark for making a relevant, correct comparison of changes in the atmosphere from the data in the table.

b) The calculation proved difficult for most candidates. Many did not seem to know that percentages should have a final total of 100.

c) Most, but not all, knew the relative amounts of gases in the air, and those who did not used guesswork which often led to a single mark.

d) Most recognised that the lack of oxygen would not allow animals to live on Earth, but fewer were able to compare inhaled and exhaled air. A common error was to state that inhaled air 'IS oxygen' and exhaled air 'IS carbon dioxide'. Many thought that ALL the oxygen was used up in exhaled air.

e) This part question was well answered. Most candidates have an understanding of the timescales involved in changes to the Earth.

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. Consequently, it was difficult for many foundation tier candidates and much lower marks were seen.

a) The commonest problem in this part question was that candidates did not add to the information they had been given. Stating that 'they use less energy' was not given any credit because they were told that the bulbs were 'low energy'. Some thought that the heat given out by filament bulbs is directly responsible for 'global warming'. Very few made the necessary link with less electricity needing to be generated.

b) Very few foundation tier candidates seemed to know about atomic structure. Some knew that the nucleus contains neutrons but 'electrons' was a common incorrect answer, as were parts of the biological nucleus, such as chromosomes or DNA. Very few realised that the number of electrons would be the same as the number of protons.

c) Most gained at least partial credit for correctly identifying some of the true and false statements about the mercury sulfide reaction. Not many recognised that all the chemicals are inorganic.

d) The main reason that some candidates scored poorly in this part question was that they did not read the information they were given thoroughly enough. Better answers made suggestions for overcoming some of the problems that Shen identified e.g. purifying the water before it enters water supplies. Some gave impractical suggestions such as 'stopping all the water and gases leaving the mine'. Few candidates seemed to be aware that industrial operations can use purification techniques to remove toxins from waste water and gases.

e) Most gained at least one easy mark for identifying jobs that need to be carried out by scientists.

6 The last question on the paper was also targeted at grades DD to CC. Again, foundation tier candidates found this question difficult. Many failed to score more than two or three marks.

a) Although most recognised that 'genetic' was linked to 'genes' or 'DNA' very few understood that it involve changing the genes. Very few understood that genetic material needs to be transferred from on organism to another.

b) Most gained at least one mark for recognising that genetic diseases are 'passed down' in the family or that infectious diseases 'can be caught'. Fewer gave both points.

c) Vague responses cost marks here. Answers such as 'it could cure you' were not given credit. Few gave a clear benefit of curing people of colour blindness. Similarly, the against answers were often too vague. Common answers included 'it might make you worse' or 'it might go wrong'. In (ii), very few candidates could identify the two genetic diseases, but most at least guessed, often gaining one of the two available marks.

d) This question was poorly answered. Some candidates misunderstood the question and attempted to give answers that began with the letters 'A' and 'B' such as 'birth'. 'Genetics' was not accepted as an alternative to 'genes'.

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. Some, apparently able candidates where making intelligent guesses at answers without the scientific knowledge that would help. It is expected that candidates on the higher tier are able to give appropriate definitions or explanations of scientific terms in the specification. Common errors involved the following terms: 'organic', 'genetic engineering, 'anaerobic' and 'renewable'. Overall chemical equations contained many errors in this session.

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 higher grades.

Comments on Individual Questions

1 This question was targeted at standard demand and overlapped with the Foundation paper

a) Candidates most commonly repeated the stem of the question stating 'less energy', without relating to how the electricity has been produced. A large number of candidates also thought that the actually light bulb produced carbon dioxide and that it's heat production was a significant contributing factor to global warming.. Very few made the necessary link with less electricity needing to be generated and hence less fossil fuel use.

b) Only about half the candidates appeared to be familiar with atomic structure.

i) The most common error was electrons.
ii) A range of numbers were given for this question, indicating that candidates missed the key proton number information given in the question.

c) Most gained at least partial credit for correctly identifying some of the true and false statements about the mercury sulfide reaction. Not many recognised that all the chemicals are inorganic.

d) Many candidates got the idea of filtering and preventing the water entering land and water supplies. But a lot also referred to stopping the water and gases leaving the mine without stating how this would be done. By far the most common error was to suggest the mine should be moved away.

e) Most candidates on the higher tier scored both marks for identifying scientific jobs.

2 This question was targeted at standard demand and overlapped with the Foundation paper

a) i) Many linked genetic engineering to the changing of DNA/genes, although few described the genes being moved between organisms, some described inheritance of genes.
ii) Most gained marks for recognising that genetic diseases are inherited within the family or that infectious diseases can be caught. Weaker candidates gave the answer 'born with' without further explanation.

b) i) Few marks were given 'for' as the majority of answers were to vague, most commonly 'see better' and 'see colour'. However marks were often given for 'against' with good explanations given. Common answers not worth credit included 'it might make you worse' or 'it might go wrong'.
ii) Only the more able candidates identified both diseases, tuberculosis and polio was common errors

c) 'A' was correctly given as genes by many candidates,. given marks more often than 'B' was less commonly identified as sexual, natural was a common error. 'Genetics' was not accepted as an alternative to 'genes'

3 This question was targeted at high demand

a) i) Most candidates scored the oxygen mark, but only a few the natural greenhouse effect. 80% nitrogen was the most common error
ii) A lot of candidates described the recent changes in the earths atmosphere and an increase in carbon dioxide. The most commonly awarded mark was for plants using/giving off carbon dioxide.

b) Few marks were given for this question. 'Convection currents' was the most common correct answer but usual given with no further explanation

c) Most candidates recognised that the size of Pluto was a factor, but very few realised that the orbit was unusual because it came inside Neptune's orbit. The incorrect answers appeared to attract equal numbers.

4 This question was targeted at high demand. Few candidates were familiar with the details of respiration required by this question

a) i) Generally well answered, with marks most frequently given for O_2 and H_20. $C_6H_{12}O_6$ was usually correct, when attempted.
ii) Marks were rarely given for this question as candidates failed to relate breathing rate to increase in blood CO_2 levels and involvement of the brain. Most answers were vague references to shortages of oxygen.
iii) Many candidates stated CO_2 as being harmful rather than the required toxic/poisonous

b) Most candidates correctly identified the movement of the ribs, although many failed to state the correct movement of the diaphragm. Very few obtained the second mark, with the major stating that the pressure of the lungs became 'higher' during inhalation.

c) This part of the question was answered reasonably well with marks often being awarded for reference to insufficient oxygen, and frequent references to anaerobic respiration and lactic acid production. However few candidates gave comprehensive answers including all these points.

5 This question was targeted at high demand

a) This was answered well with at least one genuine property usually described. Most commonly correct answers were light and stronger.

b) i) The most common error was drawing a 'spaghetti' like model, representing a tangle of molecular chains, with no clear cross links representations.
ii) Many stated that polymer B simply had a higher melting point rather than it did not melt. Marks were most commonly awarded for stating that polymer A melted.

c) i) Many candidates realised that the same number was needed on both sides of the equation, but only a few used the O_2 to give the number needed as 2.
ii) Very few drew the correct electronic structure for the ion, and even fewer gave the correct symbol. Many simply copied or added extra electrons indiscriminately to the shells.
iii) This was poorly answered with many candidates apparently thinking Magnesium oxide was a covalent compound. Most candidates were aware that it contained different types of atom.

6 This question was targeted at high demand. A pleasing proportion of candidates performed well with this set of calculations.

a) The usual errors here, with renewable energy be mixed up with recycling. used again and reused are not acceptable at this level.

b) i) Generally well answered but some candidates got the correct numbers and failed to put them in the correct boxes the correct answers were wave energy = 8250 kJ, electrical energy = 750 kJ and wasted energy = 7500 kJ.
ii) Most mistakes were made when candidates incorrectly recalled the formula to calculate efficiency. The correct answer was 91%

c) Often answered correctly, but some candidates tried to divide the numbers, again unable to recall how to carry out the calculation.
The correct answer was 2.4 m/s.

d) i) Some candidates managed to calculate the correct value, other common calculation resulted in the correct answer in joules without the candidates stating the units, which only scored a method mark. The correct answer was 18,000 kWh

ii) Very few managed to extract the required power value from the first part of 6b and rearrange the formula for this high demand calculation. The correct answer was 0.07 A.

B483: Science at Work (Portfolio)

General Comments

In this session, most Centres are 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 addressed, and the criteria are translated correctly into marks; this was particularly apparent in this unit. It is also recommended that mark bands for each criterion, for each strand, are also indicated appropriately 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.

Though marking was largely consistent in this session, little documentary evidence of internal standardisation was supplied.

For B483, as well as fulfilling the requirements of the assessment evidence grids, it should 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. There were instances where explanations were lacking, but candidates had nevertheless been awarded band 3.

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 siting 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. In instances where more than three chemical samples had been prepared, candidates should select the best two to submit.

The main area of deficiency seen was in criterion six – a review of the energy inputs and the treatment of wastes in the industrial version of the process. While some centres have now found appropriate information sources, this coverage of this criterion was absent, or minimal in others.

For criterion 1, the type of reaction was often not mentioned at all, and the level of science required when discussing the chemical reaction involved was sometimes underestimated at Bands 2 and 3. Centres should also 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.

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 e
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. Note that for band three to be awarded, *complex* processing of data is required. The calculation of growth rates is often a way of addressing this criterion at Band 3, though come Centres, commendably, are introducing statistics into their analyses of data at this level. 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'.

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 zinc carbonate/hydroxide
	preparation of silver halides
	preparation of barium sulfate

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

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 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: **9-11 marks**	11 marks for **five** criteria at band 3 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: **6-8marks**	8 marks for **five** criteria at, at least band 2 7 marks for **four** criteria at, at least band 2 6 marks for **two** or **three** criteria at, at least band 2
Band 1: **0-5 marks**	5 marks for **six** criteria at, at least band 1 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: **10-13 marks**	13 marks for **six** criteria at band 3 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: **6-9 marks**	9 marks for **six** criteria at least band 2 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: **0-5 marks**	5 marks for **six** criteria at band 1 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: **6-7 marks**	7 marks for **three** criteria at band 3 6 marks for **one or two** criteria at band 3; the **other** criteria/criterion completed at band 2
Band 2: **3-5 marks**	5 marks for **three** criteria at band 2 4 marks 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: **1-2 marks**	2 marks for **three** criteria at band 1 1 mark for **one or two** criteria at band 1

Strand d: **A report on mechanical devices (6 marks)**	
Band 3: **5-6 marks**	6 marks for **three** criteria at band 3 5 marks for **one or two** criteria at band 3; the **other** criterion/criteria completed at band 2
Band 2: **3-4 marks**	4 marks for **three** criteria at band 2 3 marks for **one or two** criteria at band 2; the **other** criteria/criterion completed at band 1
Band 1: **1-2 marks**	2 marks for **three** criteria at band 1 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: **9-13 marks**	13 marks for **six** criteria at band 3 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: **5-8 marks**	8 marks for **six** criteria at band 2 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: **0-4 marks**	4 marks for **five or six** 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

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:

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
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CB1 2EU

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