GCSE

Applied Science (Double Award)

General Certificate of Secondary Education **GCSE 1497**

Combined Mark Schemes And Report on the Units

January 2006

1497/MS/R/06J

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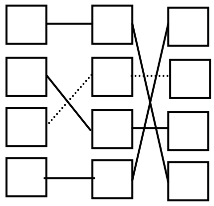
General Certificate of Secondary Education

GCSE Applied Science (Double Award) 1497

MARK SCHEMES FOR THE UNITS

REPORTS ON THE UNITS

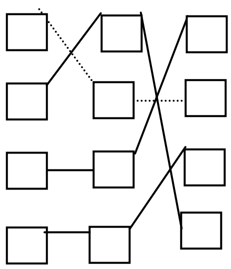
Mark Scheme 4882/01
January 2006

Qn	Expected Answers	Marks	Additional Guidance
1 a		6	
1 b	Light **and** strong;	1	
1 c	Mains - powerful / more energy / greater voltage / reliable / quick / convenient; Battery – too weak / needs replacing / charging / not enough power or energy / voltage too low; Hand – hard work / not enough power / not strong enough / takes too long / operator tires; Steam powered – dirty / labour intensive / time / fuel needs replacing;	1 1 1 1	NOT idea of fossil fuels running out NOT pollution
	Total	**11**	

2 a	increases; oxygen; glucose; energy; lactic; anaerobic;	5 max	6 = 5 5 = 4 4 = 3 3 = 2 2 = 1
2 b i	plots correct (± ½ square); Lines correct;	1 1	Award 2nd mark if plot is incorrect but curves are acceptable NOT straight lines
2 b ii	Similarities Similar shape / both have growth spurts; both have peaks; end up with same height gain; Differences Peak at different times; Peak at different heights; Data correctly quoted;	3 max	Read similarities and differences together and then award marks accordingly Max 2 marks in one area
2 b iii	different sex / only shows Luke's gain / don't know boys average;	1	
2 b iv	graph only shows gain / graph doesn't show an actual height;	1	
	Total	**12**	

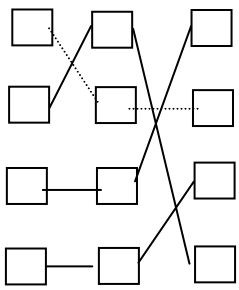
3 a i	40%;	1	
3 a ii	(Lost as) heat / (lost into) atmosphere;	1	
3 b	30 + 40 / 100 – 30; 70;	1 1	ACCEPT 70/100 for working mark
3 c	carbon dioxide causes / increases global warming or greenhouse effect; (polar) ice caps melt / sea level rise; weather more violent / unpredictable / changes in weather patterns;	3	BUT Sea levels rise causing flooding = 2 marks
3 d	wind; wave; nuclear; bio fuel; hydroelectric; solar; tidal; If no mark gained for 'energy resources' reference to the need for 'renewable energy' gains one mark	2 max	ACCEPT geothermal NOT sun NOT water, but treat as neutral ACCEPT one source and a correct explanation
	Total	**9**	

4 a i	Silicon dioxide;	1	ACCEPT water / H_2O
4 a ii	Sea water / air;	1	
4 a iii	Iron Fe;	1	Both needed ACCEPT silicon Si
4 b	Adv: idea of will withstand a lot of pressure / strong / hard wearing / can be shaped; Dis: rusts / may buckle under pressure;	1 1	IGNORE waterproof / will not leak IGNORE heavy
4 c i	Respiration;	1	NOT anaerobic respiration
4 c ii	Sodium oxide; Sodium carbonate; CO_2;	1 1 1	
4 c iii	Gets heavier;	1	
4 d	Idea of limitation of material: iron may buckle, glass crack, pressure break diving bell etc; Idea of limitation of air / not enough oxygen; Carbon dioxide may build up (and cause suffocation);	2 max	IGNORE explode
	Total	**12**	

5 a i	People / animals move (across borders); Flu is infectious / passes between people; Idea of breathing in virus / droplets (from other people);	2 max	ACCEPT contagious NOT just airborne
5 a ii	Only a small number of cases / numbers kept down by vaccination; Because number of cases not reported; People don't go to doctors;	2 max	
5 b	3 from microorganism / flu changes / different types of flu; by mutation; body makes antibodies; antibodies only work against a specific shape / flu / virus / antigen; shape change means antibodies don't work;	3 max	Only penalise incorrect reference to antigen once and give max 2 marks
5 c	viruses;	1	
5 d		6	
	Total	**14**	

6 a	1 useful; 4 spread; 2 fossil; 3 energy;	1 1 1 1	
6 b	2nd; 5th;	1 1	
6 c i	ring round coil in box;	1	Ring must not include part of radiator
6 c ii	more energy put to use / less energy is wasted; energy used to heat car; BUT less heat lost; at the radiator; = 2 marks	2 max	
6 d	large surface area; metal conducts heat; (large surface area) increases convection; (large surface area) increases radiation; idea of fins help air to circulate / help convection / radiation;	3 max	ALLOW fins
	Total	**12**	
	Total	**70**	

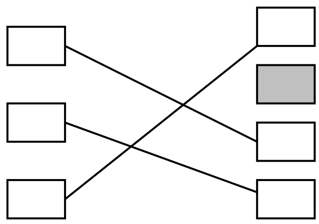
Mark Scheme 4882/02
January 2006

Question	Expected answers	Mark	Additional guidance
1 a i	people / animals move (across borders); flu is infectious / passes between people; idea of breathing in virus / droplets (from other people);	**2 max**	ACCEPT contagious NOT just airborne
a ii	only a small number of cases / numbers kept down by vaccination; because number of cases not reported; people don't go to doctors;	**2 max**	
b	3 from: microorganism / flu changes / different types of flu; by mutation; body makes antibodies; antibodies only work against a specific shape / flu / virus / antigen; shape change means antibodies don't work;	**3 max**	only penalise incorrect reference to antigen once and give max 2 marks
c	viruses;	**1**	
d		**6**	
	Total	**14**	

Question	Expected answers	Mark	Additional guidance
2 a	1 useful; 4 spread; 2 fossil; 3 energy;	**1** **1** **1** **1**	
b	2nd; 5th;	**1** **1**	
c i	ring round coil in box;	**1**	ring must not include part of radiator
c ii	more energy put to use / less energy is wasted; energy used to heat car; BUT less heat lost; at the radiator; = 2 marks	**2 max**	
d	large surface area; metal conducts heat; (large surface area) increases convection; (large surface area) increases radiation; idea of fins help air to circulate / help convection / radiation;	**3 max**	ALLOW fins
	Total	**12**	

Question	Expected answers	Mark	Additional guidance
3 a i	silicon dioxide	**1**	ACCEPT water / H_2O
a ii	sea water / air	**1**	
a iii	iron Fe	**1**	both needed ACCEPT silicon Si
b	adv: idea of will withstand a lot of pressure / strong / hard wearing / can be shaped; dis: rusts / may buckle under pressure;	**2**	IGNORE waterproof / will not leak IGNORE heavy
c i	respiration	**1**	NOT anaerobic respiration
c ii	sodium oxide; sodium carbonate; CO_2	**3**	
c iii	gets heavier	**1**	
d	idea of limitation of material: iron may buckle, glass crack, pressure break diving bell etc; Idea of limitation of air / not enough oxygen / air; carbon dioxide may build up (and cause suffocation);	**2 max**	IGNORE explode
	Total	**12**	

Question	Expected answers	Mark	Additional guidance
4 a	• electricity: points relating to cable e.g. limited length / needs to be plugged in / trip over / unsightly; • fossil fuel arguments: e.g. non-renewable, global warming / use fossil fuel; • safety: idea of high voltage supply in garden / electric shock arguments / causes hazards / cable easily damaged; • solar: only works if sun shines; may not be very powerful / dim lights; not much power stored / may not last all evening; need regular cleaning; does not work in winter; easily stolen; can't turn on and off;	**4**	1 mark in each box 'only works during the day' = 0 marks
b i	uses 0.2 kW in formula; correct re-arrangement / substitution e.g. 0.2 x 6; answer = 1.2 (kWh);	**3**	1200 = (2)
b ii	answer from b i x 7; x 10 = 84 p / £0.84;	**2**	ALLOW ecf from b i MUST have units to score 2 marks
c	cost of buying; installation costs; maintenance costs; expected lifetime of system; need to know how many you need;	**any 1**	
	Total	**10**	

Question	Expected answers	Mark	Additional guidance
5 a i		**3**	
a ii	photosynthesis; plants need light to make food; photosynthesis happens faster / increased <u>rate</u>; light not a limiting factor / higher intensity of light / does not get dark at night; plants grow / photosynthesise all the time;	**2**	
b	mentions mitosis; chromosomes replicate / duplicate; copies are <u>chromatids</u>; nucleus membrane breaks down; spindle forms; in ST3 chromatids / chromosomes split / move <u>apart</u>; chromatids / chromosomes move to poles (ST4); one of each type of chromosome moves to each nucleus / new nuclei / cells are identical; nucleus reforms (and cells divide) (ST5);	**4**	
c	identical genes / chromosomes / DNA / clones / reproduction is asexual / by mitosis;	**1**	NOT just 'cells'
	Total	**10**	

Question	Expected answers	Mark	Additional guidance
6 a	as length increases, rate of growth decreases; longer molecules take longer to rot away; quotes numbers from graph e.g. 50 / 350 correctly; bacteria grow on short molecules; bacteria do not grow on long molecules;	**any 3**	
b	identifies tangled / not tangled; tangled chains give strength; chains slide over each other when stretched; snapping occurs when chains <u>break apart</u>; polymers in new bags are further apart / not touching / more gaps;	**any 2**	REJECT chains break ideas IGNORE references to chains bonded
c	cross linking / branching / join molecules together;	**1**	IGNORE closer together arguments
	Total	**6**	

Question	Expected answers	Mark	Additional guidance
7 a	hydrogen is renewable; only water made when hydrogen burns; (2nd and 3rd box)	**2**	apply list principle
b i	endothermic	**1**	
b ii	bond breaking takes in energy; bond making gives out energy; reactions take in energy if energy taken in is greater than that given out;	**3**	for 1 mark only stand alone ALLOW link between bonds and energy changes IGNORE references to breaking forces <u>between</u> molecules;
	Total	**6**	

Report on the Units
January 2006

4881: Developing Scientific Skills (Portfolio)

General Comments

In this session, the majority of Centres are to be commended for the way in which they have implemented and delivered the course, and their appropriate and accurate application of the assessment criteria. In some Centres, however, internal standardisation procedures could be improved. In their delivery of the course, Centres should not just fulfil the demands of assessment grids and specification content, but also pay due consideration to the Assessment Objectives of the unit (Centres should refer to pages 7 and 54 of the specification). A common problem, for instance, in the carrying out of standard procedures, is candidates' failure to relate their experimental findings to scientific principles (AO2). On an administration point, Centres should check very carefully their totalling of candidate marks and transfer to marks sheets. A number of clerical errors occurred once more in this moderation session.

The most successful implementation of the specification has been observed in Centres that have taken a holistic view of the course. The course rationale involves candidates obtaining and developing the necessary knowledge and understanding of science (Unit 2), carrying out underpinning practical skills in Unit 1, and then *applying* practical skills and a knowledge and understanding of science in Unit 3. Candidates in one Centre, for instance, in their study of products from microorganisms for Unit 2, linked in yeast cell-counting techniques in Unit 1, to monitoring an organism and a study of their local brewery in Unit 3.

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. One Centre, for instance, linked in with their local brewery for their microscopy and microorganism standard procedures.

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.

A minority of Centres are, however, still having difficulty selecting practical activities of an appropriate nature. These must be selected carefully to be of appropriate demand for the candidates in question. This is particularly important for higher ability candidates. Moreover some Centres are still using practical activities more appropriate for a traditional type of GCSE Science qualification, while others have selected standard procedures that are not related to those cited in the specification.

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 are now applying the assessment criteria appropriately. Some are not, however, apportioning marks to each skill area as recommended by OCR, and although this should have no significant effect on the final unit mark, guidance on deriving marks is given in Appendices II and III.

In strands a, b and c, and in certain instances in other strands, e.g. the calculations in strand e, assessor annotation of student portfolios is essential in the endorsement of the level attained. Many Centres are now providing this annotation, and in a number of Centres, this has been excellent, but a small number is still limiting comments of candidate performance to URS forms. It should be noted that a level should be clearly indicated on candidates' work in *each* of the strands b-e for *each* practical activity. Many Centres are also sending copies of the standard procedures assignments that have been undertaken by their candidates to their moderator in addition to the portfolios. This information enables the moderator to judge the degree of guidance given to candidates. It is recommended that *all* Centres do this in future to help to facilitate the moderation process.

A minority of Centres still continues to include superfluous material and notes in student 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

The marking of this strand was often too generous, but many candidates' portfolios have been of a very high standard indeed. A number of candidates are presenting photocopied material and material printed directly from the Internet in their portfolios, but Centres are rightly appreciating that this work would usually only achieve Level 1. Some candidates are using such printouts but highlighting salient points and annotating certain sections to show a much higher level of attainment. To attain Level 3, candidates must show and in-depth understanding of the subject material, and this is best demonstrated by the application of the principles of Health and Safety to new situations, for instance on industrial visits. The best portfolios seen in this strand invariably used a diverse and imaginative range of visual material to illustrate the principles involved. Candidates working towards Level 3 should also have used a wide range of information sources. This should be indicated in a References' List, written with appropriate detail according to an accepted convention. For their Level 2 candidates, some Centres have used proformas, which have included a column for candidates to give a simple justification of the information sources used, to great effect. Copies of worksheets, assignments or handouts given to Candidates would assist in the moderation process, in pinpointing those references found independently by the candidate.

In many centres, the levels of the three mini-reports produced were often inconsistent. Centres should note that the three components – Hazards and Risks, First Aid and Fire Prevention – carry equal weighting. Failure to complete all three activities may limit candidate performance.

Strand b
Carry out Risk Assessments

It is recommended that Centres provide appropriate proformas for Risk Assessments and give guidance to the less able students so that *all* students 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.

Risk Assessments were frequently given too generous a mark in Centres. They were often too simplistic and generic. A common fault was to list many generic hazards and their associated risks. In some cases, Centres awarded Level 3 for a Risk Assessment produced with 'little guidance' while ignoring the words 'full' and 'appropriate' in the assessment criterion. 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. Many candidates designated acids or alkalis 'very corrosive' without considering the concentration used.

Strand c
Follow standard procedures involved in practical tasks using scientific equipment and materials

In some centres, the confirmation of student competence 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. 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. It is not appropriate, for instance, to award Level 3 in this skill area if units are missing from tables and axes from graphs. Careful and accurate measurements should include measurements to the appropriate number of decimal places. For titration readings, for instance, volumes should be recorded to the nearest 0.05 cm^3, and should be expressed to two 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 usually limit achievement to Level 1. It is possible, however, for candidates to use writing frames and still achieve Level 2 if the data to be recorded are particularly complex, e.g. the counts from a series of cells of a haemacytometer. When awarding high levels for microscope diagrams, Centres should ensure that candidates are producing these accurately and also, not simply replicating textbook versions.

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. If repeats are not considered necessary, candidates should *always* comment on this.

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 dependent and independent variables, or having omitted units, were nevertheless awarded Level 3 by Centre marking. In another instance, the gradient of a graph purported to show electrical resistance when the axes had been drawn the wrong way round.

Strand e
Analyse and evaluate data

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

To achieve Levels 2 and 3, students must make appropriate calculations. 'Simple' calculations at Level 3 include means, percentages, magnifications (eyepiece x objective lenses) and simple substitution in equations. 'Sophisticated' techniques include calculations involving the rearrangement of equations (for instance, for titration calculations or V = IR for calculations of electrical resistance), scales on cell diagrams, cell counts using haemacytometers and titration calculations. Centres should annotate candidates' work indicating the formulae given to make their calculations.

At Level 3, students 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.

Comments relating simply to how successful the standard procedure was are credited with no more than Level 1. At Level 3, students should comment on strengths and weaknesses of the procedure, including accuracy, precision and sensitivity of 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.

Standard procedures should be chosen carefully so that it is possible for higher level candidates to attain Level 3 for calculations, conclusions and evaluations, if this is appropriate.

Appendix I Practical activities undertaken

Microscopy
Preparing temporary slides of onion cells
Preparing temporary slides of cheek cells
Examining prepared slides of plant and animal tissues
Yeast cell counts (using haemacytometers)
Comparing fibres

Microorganisms
Serial dilutions and plate counting
Antibiotic sensitivity testing
Antiseptic and disinfectant sensitivity testing
Investigating the effects of antibiotics on *Escherichia coli* (could also extend to Unit 3)
Serial dilution of cultures of microorganisms, e.g., yeast, *E.coli*
Using a bubble counter to monitor the effect of sugar concentration on yeast (linked with Unit 3)

Qualitative analysis
Identification of unknown salts
Forensic science case (testing for anions and cations)
Testing water for pollution
Chromatography of ink
Analysis of metals in coins - Chromatography of metal ions

Quantitative analysis
The concentration of ethanoic acid in vinegar
Determining aspirin concentration by titration
Determining the concentration of hydrogencarbonate ions in ear drops

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
Dimmer switch

Other physical properties
Properties of food packaging materials
Properties of insulating materials
Building bridges
The thermal conductivity of materials
Materials for housing

Appendix II Awarding of marks

Strand a
A report on research into working safely in science, including:

- **hazards and risks**
- **first aid**
- **fire prevention**

Level 3: 10-11 marks
11 marks for **all** completed activities at Level 3
10 marks for **two** completed activities at Level 3

Level 2: 7-9 marks
9 marks for **all** completed activities at Level 2
8 marks for **two** completed activities at Level 2
7 marks for **one** completed activity at Level 2

Level 1: 0-6 marks
6 marks for **all** completed activities at Level 1
3, 4 or 5 marks for **two** completed activities at Level 1
1 or 2 marks for **one** completed activity at Level 1

Strands b-e

Their laboratory notebook or file also needs to include records of six practical activities - one in *each* of the following areas:

- **microscopy**
- **microorganisms**
- **qualitative analysis**
- **quantitative analysis**
- **electrical properties**
- **other physical properties**

Candidates' level of attainment is assessed by the level they attain in each practical skill, i.e. strand

Strand b
Carry out risk assessments

Level 3: 6 marks
6 marks for **six** completed Risk Assessments at Level 3

Level 2: 4-5 marks
5 marks for **six** Risk Assessments completed to *at least* Level 2
4 marks for **three** or **four** or **five** completed Risk Assessments at Level 2,

Level 1: 0-3 marks
3 marks for **six** Risk Assessments completed to *at least* Level 1
2 marks for **three**, **four** or **five** completed Risk Assessments at Level 1
1 mark for **one** or **two** completed Risk Assessments at Level 1

Strand c
Follow standard procedures involved in practical tasks using scientific equipment and materials

Level 3: 8-9 marks
9 marks for **six** completed activities at Level 3
8 marks for **four** or **five** completed activities at Level 3

Level 2: 6-7 marks
7 marks for **six** activities completed to at least Level 2
6 marks for **four** or **five** completed activities at Level 2

Level 1: 0-5 marks
5 marks for **six** activities completed to at least Level 1
3 or 4 marks for **four** or **five** completed activities at Level 1
1 or 2 marks for **one, two** or **three** completed activities at Level 1

Strand d
Make observations and obtain and record measurements

Level 3: 9-12 marks
12 marks for **six** completed activities at Level 3
11 marks for **five** completed activities at Level 3
10 marks for **three** or **four** completed activities at Level 3
9 marks for **one** or **two** completed activities at Level 3

Level 2: 5-8 marks
8 marks for **six** completed activities at Level 2
7 marks for **five** completed activities at Level 2
6 marks for **three** or **four** completed activities at Level 2
5 marks for **one** or **two** completed activities at Level 2

Level 1: 0-4 marks
4 marks for **six** completed activities at Level 1
3 marks for **five** completed activities at Level 1
2 marks for **three** or **four** completed activities at Level 1
1 mark for **one** or **two** completed activities at Level 1

Strand e
Analyse and evaluate data

Level 3: 9-12 marks
12 marks for **six** completed activities at Level 3
11 marks for **five** completed activities at Level 3
10 marks for **three** or **four** completed activities at Level 3
9 marks for **one** or **two** completed activities at Level 3

Level 2: 5-8 marks
8 marks for **six** completed activities at Level 2
7 marks for **five** completed activities at Level 2
6 marks for **three** or **four** completed activities at Level 2
5 marks for **one** or **two** completed activities at Level 2

Level 1: 0-4 marks
4 marks for **six** completed activities at Level 1
3 marks for **five** completed activities at Level 1
2 marks for **three** or **four** completed activities at Level 1
1 mark for **one** or **two** completed activities at Level 1

Appendix III Recording and derivation of marks

Unit 1 Developing Practical Skills			
Candidate:			
Strand a			
Level	**1**	**2**	**3**
Hazards and risks			
First Aid			
Fire Prevention			
Number at level			
Strand a total			

Practical activity strand	**Strand b**			**Strand c**			**Strand d**			**Strand e**		
Level	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Microscopy												
Microorganisms												
Qualitative analysis												
Quantitative analysis												
Electrical properties												
Physical properties												
Number at level												
Strand total												
Unit 1 total												

4882/01: Applied Science Double Award (Written Examinations)
January 2006: Foundation Tier

General comments

Overall the performance of the candidates was good and showed further improvement for this element of the Applied Science course. This continuing trend reflects both the ability of the candidates to tackle the questions and the teaching and learning strategies employed within Centres.

There were no scripts where there were significant areas of nil response; all candidates clearly felt confident enough to **attempt** all of the questions at the very least. The lowest marks were in the mid-teens, but these marks were very rare. At the other end of the range, marks in the forties were reasonably frequent with a small number of candidates scoring over fifty.

The Standard Demand questions (4-6 inclusive) aimed at the C/D grades were very well answered by a large number of candidates. It was encouraging to see so many good answers to these more demanding questions where responses have fallen away in the past.

Comments on individual questions

Q1

This question enabled the **vast** majority of candidates to get off to a good start to the paper although a surprising number answered 'conductor' or 'brittle' with 'strong' in part (b). The main error in part (c) was with the last response where answers along the lines of non-renewable for the coal were fairly common.

> Teacher tip: Focus students on energy sources at the point of use as well as wider, global issues

Q2

The first part of the second question continued the solid start for virtually all candidates. The errors, when there were any, tended to be in the second response (error: energy or glucose) and/or the last one (error: aerobic). Most candidates found 2(b)(i) difficult; the actual plot (0.2), given the scale of the graph, was a tall order for the youngsters whilst the curve drawing, either to the correct point or their own erroneous one, required a high level of graphical skill. Similarly, the demands of 'height gain' in (b) (ii—iv) gave most candidates great difficulty as did the data interpretation **related** to height gain. In hindsight this was a difficult question aimed at low demand and appearing so early in the paper.

> Teacher tip: Stress the importance of labels on graphs and encourage students to relate this information to the **actual** graphical data in their answers.

Q3

Although the vast majority of candidates gained the 40% mark in (a)(i), an unexpectedly high number failed to give ‘heat’ or where the wasted (energy) had gone to in part (a)(ii).

(b) Was generally well answered, but a repeat of the 40% in part (a), or 60% (i.e. 100- 40), were the usual errors.

(c) A lot of candidates gave excellent answers but some were confused by the reduction of carbon dioxide emission and answered in terms of increased global warming and its consequences. Absolute answers (i.e. **stops** global warming or **stop** weather patterns) hindered potentially good answers from gaining full credit.

(d) Generally yielded two marks with candidates giving two correctly named renewable energy resources.

Teacher tip: Stress the ideas associated with an increase **and** a reduction of the level of carbon dioxide emissions on global warming and the consequences of both in terms of their effects on the greenhouse effect and climate change.

Q4

Many candidates gave correct answers to parts (i), (ii) and (iii), but a significant number made the mistake of reversing compounds and mixture in the first two parts and being unable to recall the symbol for iron after giving the correct initial response. An encouraging number of correct answers were given in (b) although references to ‘conductor’ and ‘waterproof’ were seen infrequently.

(c) (i) The common errors here were to give the traditional incorrect response of ‘breathing’ or ‘anaerobic’ respiration.
(ii) The success rate was rather disappointing despite a detailed introduction where the names to be used in the word equation were given. Sodium oxide and, to a lesser extent, carbon dioxide were commonly picked up but ‘sodium carbonate’ appeared to be too difficult for all but a few candidates.
(iii) A lot of ‘gets lighter’ answers were given here.

(d) Many candidates gave excellent answers in this part of question four. Answers not worthy of credit constructed around ‘hard to pull up’ were occasionally seen together with the idea of more pressure on the **occupants** of the diving tank.

Teacher tip: Encourage and train students to carefully study the information given in questions involving chemical reactions and transfer the names into the word equation. Stressing that splitting into reactants and products may also help.

Q5
This proved to be the most problematic **complete question** on the paper (part (d) in question 6 also comes into this area of difficulty). Indeed, it was the successful answers to part (d) that salvaged a good score in this question for most candidates.

(a) (i) Candidates scored one of the marks but **rarely** both. This was also the case in (ii), the most common response being ‘only a few cases’, although the idea of ‘vaccination’ was given but was a less popular answer.

(b) This proved to the most difficult part of the question paper (along with 6(d)). The most frequent score was ‘1’, predominantly for the ‘different types of flu’ response. Candidates did not appear to know, or understand, the mechanism of the body’s response to vaccinations.

(d) As stated previously this was a much better part question for virtually all candidates. When four marks were gained the two marks dropped were in the left-hand links (bacteria linked to athlete’s foot and fungi to tuberculosis being the all too frequent misconceptions).

> Teacher tip: The use of diagrams similar to those used in the question could help students to discuss of mutation of flu viruses and lead to an explanation to the body’s response by producing antibodies that work against a specific shape or antigen.

Q6
Part (a) enabled candidates to get off to a confident start to the final question on the paper. Most gained 3 or 4 marks, the one error for clue 4 being ‘safely’ rather than ‘spread’.

(b) Reasonably good in terms of the gain of 2 marks. If only one mark was gained box 4 was the one that produced the most popular misconception.

(c) (i) There was an approximate 50/50 split between car engine and the radiator and the correct answer related to the ‘coil’. Many candidates gained the heating of the car mark or the idea of less energy wasted, but rarely both.

(d) Candidates found this very difficult. This was understandable as it was a more difficult overlap question. Metal being a conductor (of heat) or the large surface area frequently produced a mark but vague, disjointed prose, with incorrect or unjustified references to convection or radiation rarely gained any further credit. Reference to heat ‘particles’ was another common error.

> Teacher tip: Continue to stress; particles <u>of</u> the solid (metal) for conduction, particles <u>of</u> gases/liquids move for convection but NOT **<u>heat</u>** particles.

4882 02: Applied Science (Double Award) Higher Tier

General Comments

The quality of answers given by candidates was judged by examiners to be higher than in previous sessions, and follows a generally improving trend. A significant proportion of the candidates earned very high scores and these candidates were very well prepared for the examination.

The candidates showed good use of time in the examination. Most attempted all the questions and used guesswork in an appropriate way when they were given 'choice' type questions rather than leaving blanks.

However, some candidates were not adequately prepared for the higher tier component. The questions that test the most difficult constructs are targeted at testing achievement at grades A*A* to BB. Examples from this paper include 5b (mitosis), 6 b (polymer structure) and 7 b ii (energy changes in the context of bonds). Some candidates did not score in these question areas, implying that they had not studied the more difficult areas of the specification. Such candidates would be better advised to tackle the foundation tier paper. The higher tier paper demands that candidates have a grasp of all specification areas. A minority of candidates produced only very low scores implying that they would have been better served by attempting the foundation tier paper.

To improve performance in future sessions, examiners commented on two other areas for improvement. Candidates need to know the 'key' words that define the most important learning objectives on the specification. Terms such as compound, mixture, element and endothermic appeared on this paper and were not well known by all candidates. Secondly, candidates need to make enough clear points to access all marks in part questions with multiple marks. In some cases, answers were too vague to score, e.g. 'unreliable' as a disadvantage for solar energy is too vague, but 'only charges when the sun shines' is a better answer.

Candidates need to know all the chemical symbols and formula given in the specification appendix list.

Comments on Individual Questions

Q1

The first three questions were 'overlap' and shared with the foundation tier. These questions are designed to discriminate between grades CC to DD and so produced generally high scores for higher tier candidates.

(a) Surprisingly few candidates on the higher tier gained two marks. Most commented that people travel between countries, but many seemed to think that viruses are transferred 'through the air' rather than directly between people. For part (ii), again, many scored one rather than two marks, usually for mentioning that this meant that there were only very few cases. Higher tier candidates need to make sure that they make two clear points when two marks are available.

(b) Most gained an easy mark for recognising that the flu virus changes. Some correctly discussed mutation. However, few correctly discussed the role of antibody production or the specificity of the shape of the antibodies. Most seemed to think that the vaccination works directly against the flu.

(c) Answers were equally spread between bacteria (incorrect) and viruses (correct), implying that candidates were using 'intelligent guesswork' when they were unsure.

(d) Everyone knew the correct treatment for the diseases and that fungi causes athlete's foot. The commonest error was to confuse bacteria and viruses as causes for TB and foot and mouth.

Q2

(a) A very easy four marks for higher tier candidates.

(b) No problems here either, although a minority did not gain both marks.

(c) Most correctly identified the heat exchanger, although some circled the radiator, perhaps because they knew that a radiator contains a heat exchanger even though there was not one drawn on this diagram.
In part (ii), most knew that the energy efficiency was increased when the heat was used inside the car, but fewer made a clear statement that this was due to a lower proportion of the heat being wasted.

(d) Candidates found this difficult. The question specifically asked candidates to discuss conduction, convection and radiation in their answers. Some did not do this, and some confused the terms. Further confusion was revealed by some who discussed hot water or air moving in and out of the radiator. These sources of confusion meant that most only gained a single mark here. The best answers clearly identified where each process happened e.g. the metal conducts, the fins increase radiation due to the increase in surface area and air circulates in the gaps to increase conduction.

Q3

(a) This is a very common type of question for overlap questions. Some were unsure of the difference between elements, compounds and mixtures and so lost these few marks. The specification appendix of compounds and elements that need to be known by candidates is sometimes overlooked in preparing for the examination. Hence, not all knew that the symbol for iron is 'Fe'.

(b) This was well answered, despite vague wording such as 'can't handle the pressure' rather than 'may crack under pressure'. Some gave 'heavy' as a disadvantage. This was not accepted as heaviness is an advantage for a diving tank.

(c) Most correctly knew 'respiration' is the process that produces carbon dioxide, although some gave 'breathing' as an incorrect answer. The equation was well done by most, although again, not all knew that compounds containing 'CO_3' are carbonates (the specification formulae appendix again) and so gave incorrect names such as 'sodium carbon oxide'. Most realised that the sodium oxide would increase in mass, although the distracters were often chosen too.

(d) The idea of increase in pressure confused some candidates who thought that the air pressure would increase, harming the divers. Again, some vague answers such as 'can't take the pressure' were given, but most gained at least one mark for commenting on either the shortage of oxygen or rise in carbon dioxide or by commenting of the danger of the tank breaking.
The remaining questions were targeted at higher demand (BB to A*A*). The scores were correspondingly lower. The mark scheme for these questions is generally more rigorous and weaker answers are more likely to be rejected.

Q4

(a) 'Advantages and disadvantages' type questions often score poorly, even though candidates themselves do not perceive them as difficult. This is usually because the answers given are too vague to score. Most candidates know in principle the advantages and disadvantages of mains and solar energy, but their answers typically were in the form of very generalised comments rather than specific, scientific features. When discussing mains electricity, answers such as 'you need a cable' or 'the cable may be dangerous' were not given any credit. Better answers were 'needs access to a mains socket' or 'electricity comes from non-renewable sources'. For solar energy, 'only works during the day, not at night' was a common misconception; candidates failed to realise that the lights charge during the day and give out light at night.

(b) The calculations were correctly carried out by more able candidates. The two key skills that are commonly tested on higher tier calculations is the ability to rearrange a formula, and the ability to convert units. In this case, many failed to rearrange correctly, commonly dividing power by time. Also, a unit conversion from W to kW was needed. This was often overlooked.
The 'cost' calculation gained partial credit for most. Error carried forward was allowed if the candidate used their answer to (i) correctly. Most knew that it was necessary to multiply by seven then ten. However, the pence and pounds were often confused, with answers in pounds given as pence and vice versa. Where the answer to (i) was wrong, very large answers to (ii) were quoted e.g. £840. Candidates did not generally 'work back' by noticing that this value must be wrong.

(c) Many said that the 'running costs' or 'energy efficiency' of the solar lights needs to be considered, hence failing to realise that the energy for solar lights is free. The easiest answer was to state that the cost of buying the lights initially needs to be compared.

Q5

(a) The roles of the three substances in plant processes were not well known. Many gave 'respiration' for carbon dioxide, and transposed the functions of magnesium and nitrates. Most knew that light is needed for photosynthesis, but few made a second point to gain a second mark, for example by stating that photosynthesis would be continuous or faster.

(b) This part question was very poorly answered. Candidates appeared not to know the details of mitosis, and made poor attempts at describing what the diagrams on the question paper showed without bringing any knowledge into their answers. At higher tier, it is expected that candidates will discuss mitosis in terms of the cell structure, using words such as chromatid, nuclear membrane, spindle and poles. It was very rare to see such terms in answers. Most did not know that stage 2 shows chromosomes being copied. Candidates commonly stated that the chromosome 'split into two'. The only mark that was usually scored was from a comment that the chromosomes move apart at stages 3 and 4. Very few discussed the breakdown and reformation of the nuclear membrane.

(c) Almost everyone knew that the genes in the cutting would be the same, but some did not state this very clearly, 'the genes come from the parent' is true of both sexual and asexual reproduction.

Q6

(a) Again, three marks were available here, but most only made a single point. When values are given on a graph, these should be used in the answer, so 'polymer molecules with more than 350 carbon atoms do not allow the growth of bacteria' earns two of the three marks.

(b) The effect of chain length on strength was not known. The key idea was of tangling holding the chains together. This was almost never seen. Partial credit was allowed for candidates who discussed chains being closer together. However, answers which discussed bonds between chains were rejected.

(c) Cross links and side chains were not known by candidates. This is higher tier only content, and it appears that candidates had, in general, not covered this area of the specification.

Q7

(a) It is important that candidates read the question carefully. Many ticked two correct statements relating to hydrogen (they are all actually correct!), rather than identifying which two specifically relate to its use as a fuel for cars.

(b) Not all knew the term 'endothermic'.

(c) This, again, is from higher demand specification statements, and was very poorly answered. Some correctly stated that breaking bonds requires energy, but most thought that making bonds also involves energy input. The discussion of the balance between energy out and energy in was almost never seen. This type of question is very common and candidates need to rehearse their answers.

4883: Science at Work (Portfolio)

General Comments

For the portfolio work submitted in this session, it is pleasing to see that Centres are continuing to devise excellent ways of incorporating local, and other, industry into this unit, particularly in strand a.

In this session, it is notable that while some Centres' have applied the assessment criteria very accurately, a significant number of the small number of Centres submitting portfolios have been too generous in their apportionment of marks. All 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. Centres should also encourage candidates to not simply fulfil the requirements of the assessment criteria, but to organise coursework material in each section more carefully into its respective themes. Some portfolios have a rather disjointed feel; time should be spent integrating more carefully section introductions, investigations, discussion material, evaluations and industrial comparisons. In their delivery of the course, Centres should also note that due consideration should be paid to the Assessment Objectives of the unit (Centres should refer to pages 7 and 83 of the specification). Care should be taken, for instance, to carry out analyses of data, make conclusions, and evaluate their methods at a level appropriate to the candidate's potential.

As in Unit 1, teacher annotation is critical in endorsing assessor's decisions of some criteria, e.g. in strand b, in chemical reactions, for balancing chemical equations and making calculations of yields. Some Centres have clearly adopted advice recommended in previous sessions.

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

In strand a, a good deal of the work was of an excellent standard; most Centres at least reviewed local industry, while many have been very adept at establishing excellent links. It is particularly pleasing to see the evolution of those links established previously. The use of visual material is increasing and was often very effective. Candidates should be encouraged to record photographically their industrial visits where this is possible.

Candidates' had clearly devoted much energy to this section, though for many, there still tends to be some reliance corporate websites, from which some candidates print copious notes. In general, 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.

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

In strand b, a common fault continues to be that candidates have not addressed straightforward criteria, such as defining the type of chemical reaction involved for each chemical process. The chemistry underlying each chemical reaction could still be made more clear in some instances.

A key feature of portfolios of candidates working towards higher levels is that these are carefully produced, and do not contain simple errors, such as the confusion of lower and upper case in chemical formulae, and subscript and superscript in chemical equations. These candidates should also avoid the use of very prescriptive writing frames. In one publisher's materials, the writing frames necessitate calculation of theoretical yields, which is not necessary for Level 2, but are too prescriptive to enable attainment at Level 3. A few astute Centres are using appropriate writing frames to illustrate the principles of chemical reactions and yields for one or two of the reactions undertaken, then insisting that candidates carry these out independently in the third reaction. Many candidates must also try to integrate their industrial comparisons into the body text of the portfolio and not make them seem some kind of 'bolt on'.

Strand c
A report on mechanical machines and the assembly and assessment of one electronic or electrical device

For their mechanical device, candidates' portfolios have contained a series of investigations on levers, pulleys and gears. Centres should, however, be looking to adopt a more applied approach to their work. Some, for instance, have investigated levers or pulley systems in gym equipment. A common fault with some of the portfolios seen was a failure to assign units to data in a table. This will necessarily limit the achievement

The electronic devices most often constructed and tested were usually based on potential divider circuits, using thermistors or light-dependent resistors as input devices. All candidates should be encouraged to draw circuit diagrams, or at least include procedures that have been followed, so that it is clear to the Moderator how the device has been constructed. Evaluations of circuits were mostly carried out on a simple level, though some Centres made measurements, of light intensities, for instance, to give an indication of the sensitivity of switching in their devices.

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

The organisms that were monitored included yeast, stick insects, humans and other primates.

A weakness of some portfolios remains the failure of candidates to link their findings with scientific principles. One Centre carried out an investigation on reaction timing, and although this generated much data, candidates had difficulty relating this to relevant background science. A common issue was that candidates included a great deal of background information on the organism without discriminating between relevant and irrelevant material. Little had been done to integrate this material with the main body of the assignment. Some candidates, particularly those working on the nutritional requirements of plants, managed to include much of the relevant science, though this was included in a 'prediction' and not in a discussion/conclusion, where it could have been linked closely with the findings of the investigation. Some candidates, usually in instances relating to the brewing industry, managed to make industrial comparisons of monitoring techniques, though this was generally not well developed.

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
Esterification:	preparation of esters

A report on mechanical machines and the assembly and assessment of one electronic or electrical device

Inclined plane (moving a beer barrel)
Investigating levers, pulleys and gears
Simple potential divider circuits
Monitoring light and temperature in a greenhouse
A night light
Generating electricity using a wind turbine

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

Monitoring the growth of stick insects
Monitoring yeast growth (in bread and alcoholic drinks)
Monitoring human performance

Appendix II Awarding of marks

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

Level 3: 10-11 marks
11 marks for **two** completed bullet points at Level 3
10 marks for **one** completed bullet point at Level 3

Level 2: 7-9 marks
9 marks for **three** completed bullet points at Level 2
8 marks for **two** completed bullet points at Level 2
7 marks for **one** completed bullet point at Level 2

Level 1: 0-6 marks
6 marks for **three** completed bullet points at Level 1
3, 4 or 5 marks for **two** completed bullet points at Level 1
1 or 2 marks for **one** completed bullet point at Level 1

Strand b
The production of pure, dry samples from *three* types of chemical reaction:

Level 3: 10-13 marks
13 marks for **four** or **five** bullet points at Level 3
12 marks for **three** bullet points at Level 3
11 marks for **two** bullet points at Level 3
10 marks for **one** bullet point at Level 3

At Level 3, each bullet point must be addressed in at least ***one*** *chemical reaction*

Level 2: 6-9 marks
9 marks for **four** bullet points at Level 2
8 marks for **three** bullet points at Level 2
7 marks for **two** bullet points at Level 2
6 marks for **one** bullet point at Level 2

At Level 2, bullet points 1, 2 and 4 must be addressed in at least ***one*** *chemical reaction; bullet point 3 is generic*

Level 1: 0-5 marks

5 marks for	**three** completed bullet points at Level 1 bullet points 1 and 3 addressed in all **three** chemical reactions
4 marks for	**two** completed bullet points at Level 1 bullet points 1 and 3 addressed in all **three** chemical reactions
3 marks for	**two** completed bullet points at Level 1 bullet points 1 and 3 addressed in **two** chemical reactions
2 marks for	**two** completed bullet points at Level 1 bullet points 1 and 3 addressed in **one** chemical reaction or
2 marks for	**one** completed bullet point at Level 1 bullet point 1 or 3 addressed in **two** chemical reactions
1 mark for	**one** completed bullet point at Level 1 bullet point 1 or 3 addressed in **one** chemical reaction

At level 1, bullet point 2 is generic; students do not need to address this criterion for the chemical reactions carried out

Strand c
A report on mechanical machines and the assembly and assessment of one electronic or electrical device

Level 3: 11-13 marks
13 marks for **four** or **five** bullet points at Level 3
12 marks for **two** or **three** bullet points at Level 3
11 marks for **one** bullet point at Level 3

Level 2: 7-10 marks
10 marks for **four** bullet points at Level 2
9 marks for **three** bullet points at Level 2
8 marks for **two** bullet points at Level 2
7 marks for **one** bullet point at Level 2

Level 1: 0-6 marks
6 marks for **four** bullet points at Level 1
4 or 5 marks for **three** bullet points at Level 1
3 marks for **two** bullet points at Level 1
1 or 2 marks for **one** bullet point at Level 1

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

Level 3: 10-13 marks
13 marks for **four** or **five** bullet points at Level 3
12 marks for **three** bullet points at Level 3
11 marks for **two** bullet points at Level 3
10 marks for **one** bullet point at Level 3

Level 2: 6-9 marks
9 marks for **four or five** bullet points at Level 2
8 marks for **three** bullet points at Level 2
7 marks for **two** bullet points at Level 2
6 marks for **one** bullet point at Level 2

Level 1: 0-5 marks
5 marks for **five** bullet points at Level 1
4 marks for **four** bullet points at Level 1
3 marks for **three** bullet points at Level 1
2 marks for **two** bullet points at Level 1
1 mark for **one** bullet point at Level 1

Appendix III Recording and derivation of marks

Unit 3 Science at work															
Candidate:															
Strand a	**Science in the workplace**														
Level	**1**			**2**			**3**								
Bullet point	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**							
Strand a mark/11															
Strand b	**Chemical reactions**														
Level	**1**			**2**				**3**							
Bullet point	**1**	**2**	**3**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**5**			
Reaction 1															
Reaction 2															
Reaction 3															
Strand b mark/13															
Strand c	**Mechanical machines and electrical/electronic devices**														
Level	**1**				**2**				**3**						
Bullet point	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**5**		
Mechanical															
Electronic															
Strand c mark/13															
Strand d	**Monitoring an organism**														
Level	**1**					**2**					**3**				
Bullet point	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Strand d mark/13															
Unit 3 total															

General Certificate of Secondary Education
Applied Science (Double Award) 1497
January 2006 Assessment Session

Unit Threshold Marks

Unit		Maximum Mark	a*	a	b	c	d	e	f	g	u
4881	Raw	50	46	41	36	32	26	20	15	10	0
	UMS	100	90	80	70	60	50	40	30	20	0
4882/1	Raw	70	-	-	-	43	35	27	19	11	0
	UMS	100	90	80	70	60	50	40	30	20	0
4882/2	Raw	70	55	46	37	29	23	20	-	-	0
	UMS	100	90	80	70	60	50	40	30	20	0
4883	Raw	50	46	41	36	32	26	20	15	10	0
	UMS	100	90	80	70	60	50	40	30	20	0

Entry Information

Unit	Total Entry
4881	2198
4882/1	6429
4882/2	1010
4883	486

Specification Aggregation Results

Grade	A*A*	AA	BB	CC	DD	EE	FF	GG	UU
UMS	270	240	210	180	150	120	90	60	0
Cum %	1.3	11.1	48.4	79.1	87.6	93.5	97.4	99.3	100.0

359 candidates were entered for aggregation this session.

For a description of how UMS marks are calculated see;
www.ocr.org.uk/OCR/WebSite/docroot/understand/ums.jsp

Statistics are correct at the time of publication.

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