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GCSE

Physics A (Twenty First Century)

General Certificate of Secondary Education **J635**

Report on the Units

June 2009

J635/MS/R/09

Oxford Cambridge and RSA Examinations

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

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

OCR will not enter into any discussion or correspondence in connection with this Report.

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GCSE Twenty First Century Science - Physics A (J635)

REPORTS ON THE UNITS

Introduction from the Chief Examiner

Ofqual produced a public report on GCSE Sciences in March 2009: 'Findings from the Monitoring of the new GCSE Science Specifications: 2007 and 2008'. This report (page 25) makes reference to an agreement between Ofqual and the Awarding Bodies 'to ensure that grade boundaries are set appropriately'. Part of this agreement required all the awarding committees to work towards a new national standard for this summer's series. This has had an impact on both the examined units and the coursework components awarded this summer, and has resulted in higher thresholds than might have been expected for a number of the key grade boundaries, across the 21st Century Science and Gateway Science suites of specifications.

It has been a pleasure to see the performance of candidates in this assessment session. As hoped candidates have had more opportunities to score higher marks than in previous specifications and this is reflected in the high mean scores, both at foundation and higher tier.

It is clear that centres have done a good job in preparing candidates for objective style of paper of A331 and A332, with most candidates now familiar with the different styles of objective question. An issue worth noting by centres concerns the relationship between the number of marks given at the end of a part question and the number of responses required by the question. The number of marks does NOT necessarily equal the number of responses. For example a question may ask for ticks in the boxes for the best answers and have 2 marks available, but require 3 ticks in the boxes to obtain the two marks. This is quite common on higher tier papers.

Centres are reminded that this is the last examination series in the current format for these papers (A331 & A332). From January 2010, about one third of the marks from these papers will be awarded on open-ended questions. Please refer to the OCR website for further details, including specimen assessment materials. This change in the format of these papers will mean that candidates who are not able to express themselves well in free response questions are likely to do less well than in previous series. As the free response sections of Higher Tier papers will be more demanding than those in Foundation Tier, centres will need to consider carefully which paper to enter candidates for.

There was evidence that some candidates' preparation could be improved in components A333 and A339/340. In A333 too many candidates did not appear to be fully prepared on the pre-release material, they were not familiar with the physics associated with the pre-release material. The coursework components A339/A340 are worth 33% of the marks for the GCSE, too often this did not appear to be reflected in the preparation of candidates for the coursework. Each of these can result in candidates being disadvantaged.

The following reports provide more detail on how candidates performed on specific questions, highlighting areas of concern and applauding improvements from previous years.

Please ensure that your staff are encouraged to read these reports.

A331/01 – Twenty First Century Science Physics A (P1, P2, P3) Foundation Tier

General Comments

Centres are reminded that this is the last session for A331 in the current format. From January 2010 around a third of the marks from this paper will be awarded on open response type questions. Please refer to the OCR website for further details, including specimen assessment materials.

The paper was well attempted and produced a satisfactory mark.

Candidates seem to have been well prepared for this objective style of questioning.

Candidates should be aware that the marking is done from scanned images of their scripts. Consequently, if candidates change their minds, any alterations must be made clearly and unambiguously.

Any marks that are ambiguous – possibly made with the intention that the examiner could give credit for either of two possible responses, where only one is correct – will not gain credit on this paper.

The level of difficulty was appropriate for the ability range and most questions were accessible to candidates across the ability range. The majority of candidates generally performed well and marks were awarded across a reasonable range, demonstrating satisfactory differentiation.

Scores typically ranged from the high teens to the low thirties (out of 42 marks).

Most candidates correctly followed the instructions in the questions and most made their responses appropriate to the number of marks available. Some, however, did not read the questions carefully enough.

All candidates seemed to have made good use of their time.

There was no evidence of candidates running out of time.

Comments on Individual Questions

1 Parts (a), (b) and (e) were well answered for this question. For part (c) most candidates were able to score at least 1 mark. Candidates seemed fairly secure in the knowledge that the Sun was the largest object on the list. The Moon and the Earth were often transposed in wrong answers. In part (d), candidates recognised Hydrogen, but many felt that it burnt in the Sun.

2 Most candidates could answer part (a) of this question. There was a considerable degree of uncertainty with selection of answers in part (b), with many candidates reluctant to select the same answer twice. This was reflected by changes to original answers, often to the candidate's detriment. Only the more able candidates correctly named the Milky Way as our galaxy in part (c).

3 Part (b) of this question caused many weaker candidates difficulties. There was no clear pattern to the wrong answers, although significantly more candidates recognised gamma as ionising radiation, compared to those that selected ultraviolet. Parts (a) and (c) were well answered.

4 Only a small minority of candidates selected the correct calculation in part (a) of this question. Centres are reminded of the mathematical requirements for this specification, detailed in the appendix of the same name in the specification for J635. In part (b) most candidates got the 'second' and 'number' responses correct. The other 2 responses were often transposed, giving a typical score of 2 marks. "Generates vitamin D" was identified correctly by most candidates. The second choice was very variable, possibly because candidates failed to associate getting a tan as being beneficial.

5 Only part (b) of this question caused any difficulties. A significant minority of candidates tried to complete the table by writing 'alpha', 'beta' and 'gamma' in the boxes. Another common error was a candidate selecting just the minimum material to absorb the radiation, hence getting the second row of the table wrong by ticking only the first column.

6 Most candidates could only select one renewable resource from the list, often incorrectly choosing natural gas instead. In part (b) only the more able could identify carbon dioxide as the correct answer. Part (c) was well answered by all but the weakest candidates.

A331/02 – Twenty First Century Science Physics A (P1, P2, P3) Higher Tier

General Comments

Generally candidates performed very well on this paper. Most candidates appeared to be entered for the correct tier with only a very few gaining very low marks.

Candidates should be aware that the marking is done from scanned images of their scripts. Consequently, if candidates change their minds, any alterations must be made clearly and unambiguously.

The level of difficulty was appropriate for the ability range and most questions were accessible to candidates across the ability range. The majority of candidates generally performed well and marks were awarded across a wide range, demonstrating appropriate differentiation. Scores typically ranged from the mid teens to the high thirties.

Most candidates correctly followed the instructions in the questions and most made their responses appropriate to the number of marks available. Some, however, did not read the questions carefully enough.

All candidates seemed to have made good use of their time. There was no evidence of candidates running out of time.

Comments on Individual Questions

1 a Most candidates gained both mark on this question with only a small minority getting the order wrong. This was designed as a gentle start to the exam.

b Most candidates gained the mark on this question with very few choosing the “exactly…” options, which was very pleasing.

c Candidates tended to get this mark although a number were distracted by the fission of hydrogen. Hardly any went for helium.

d Candidates preformed well on this question , which show that centres are now focusing on the Ideas About Science (How Science Works) areas well. Centres should be congratulated.

2 a Most candidates performed well here but a surprising number thought that scientists had visited stars.

b Very well answered and the inclusion of working out showed that candidates clearly understood the log notation very well.

c The vast majority of candidates gained credit here with the most common wrong answer being “ Solar System”

3 a Again candidates performed really well here and radio waves was the most popular answer.

3 b The majority of candidates gained the mark here even though they needed 3 items to get the mark. Visible light was a common answer even though it was not in the list, but this answer was given credit.

c The mark for non ionising radiation was gained by most candidates but knowing that ionising radiation also caused damage by heating was missed by many candidates.

d Approximately half of the candidates knew the sievert as the correct answer although counts per second was a very common mistake.

e This question was very well answered and candidates tended to gain full credit here.

4 a The calculation was correctly circled by over half of the candidates which was pleasing. In future exams this type of question is likely to be replaced by a calculation the candidate has to perform themselves.

b Candidates found the first mark for "second" relatively easy to get. The second mark was only a little harder with most going for "distance". The last 2 marks were more difficult and only the very best candidates gained full credit on this question.

c Centres should be congratulated with the way they have taught the correlation and cause and the precautionary and ALARA principles. The standard of answers to this question was very high and candidates had clearly been prepared very well.

5 a Candidates tended to get one of the two answers required for the mark on this question. On the high level paper the number of marks does not always tell candidates the number of responses that are required.

b Television signals and mobile phones were strong distracters here and a number of high performing candidates did not get both marks on this question.

ci Most candidates could answer this question with the first option being the next most popular option.

cii This was a question that only the very best candidates answered correctly. Many candidates ticked the "chemically react the material with oxygen" as the answer.

d It was very pleasing to see the large number of candidates who knew the uses of radioactive materials and gained full credit here.

e This question was very well answered and the majority of candidates scored all 3 marks. It was pleasing to see that candidates could use their knowledge of radioactivity in context.

6 a Most candidates gained the mark here and those that didn't tended to have only 2 of the 3 correct answers circled.

b Candidates have shown a good understanding of this subject and could clearly decide if the statements were "for", "against" or "neither", with over ¾ gaining 3 marks. Again centres should be congratulated over the improvement in the understanding of candidates of this area of debate.

c Candidates answered well and gained credit widely here. Again centres are to be congratulated.

A332/01 – Twenty First Century Science Physics A (P4, P5, P6) Foundation Tier

General Comments

This paper is designed for candidates operating in the G-C range. There was no evidence to suggest that candidates had been inappropriately entered for the paper nor was there any evidence that candidates had any time difficulties with the vast majority completing in the time allowed.

Candidates should be made aware that the marking is done from scanned images of their scripts. Consequently, if candidates change their minds then any alterations must be made clearly and unambiguously. Any marks that are ambiguous will not gain credit on this paper.

Comments on Individual Questions

1 This question was well answered by the majority of candidates. The most common error occurring in part (a)(i) was the drawing of a non linear line from the origin to (1.5 min, 30m/s) even though the question clearly stated that the increase in speed was 'steady'. In part (a)(ii) some weaker candidates had difficulty in identifying the correct unit (km/h) whilst part (b) was well answered.

2 The vast majority of candidates gained both marks in part (a) but only one in part (b) with many incorrectly stating that 'Bobby has the same kinetic energy as his dad' or 'Bobby's dad goes faster because he is heavier'.

3 Part (a) was reasonably well answered but part (b) proved more difficult with many identifying gravity and not friction as the force required in walking, stating that the forces were in the same direction and not opposite and called them reaction forces as opposed to interaction.

4 Parts a(i) and (ii) were usually answered correctly but in part (iii) the answers varied from less than a penny to several thousand pounds. Part b(ii) proved difficult for many candidates with the majority correctly identifying a transformer being made of two coils on an iron core, but far fewer stating that it requires an alternating voltage to work. In part (c) the majority knew where to place the voltmeter but weaker candidates found difficulty in knowing that the current remains the same in a series circuit.

5 This question was a common question with the higher paper and was mainly targeted at the C/D grade candidates. In part (a) the majority of candidates gained the mark for energy being transferred to the kettle when an electric charge flows through the kettle but then lost the second mark by stating that all the energy transferred to the kettle goes in heating the water. Some tried ticking three boxes and therefore lost a mark. Part (b) was poorly answered by all candidates with only a minority gaining even one mark, candidates need to know that energy supplied is a product of power and time and be able to work in both kWh and J. It was the last answer, 360,000J that was more often missed.

6 The answers to this question were rather disappointing. In part a(i) candidates were asked to place three missing parts of the electromagnetic spectrum correctly into a diagram of the spectrum, a type of question that had been asked many times in the past, but a considerable number placed all three in the wrong boxes. Part a(ii) was far better answered with the majority knowing the uses for the different parts of the spectrum. It was surprising the number who in part b(i) could not identify a digital signal as being made of '0 and 1s' although it was less surprising that candidates did not know a television has to decode the signal to produce a copy of the original. The majority did know that digital signals usually have higher quality.

7 Candidates who knew that either the wavelength or frequency was different for different coloured lights usually also knew that the speed remained constant but weaker candidates often lost both marks.

8 This question was an overlap with the higher paper and part (a) often proved difficult. A considerable number of candidates did not know that it is the amplitude of waves that add together, often the incorrect answer being wavelength, and that waves meeting in step will produce constructive interference and a bright area. Part (b) recognising diffraction was answered much better.

A332/02 – Twenty First Century Science Physics A (P4, P5, P6) Higher Tier

General Comments

The Higher tier paper is designed to test the knowledge and skills of candidates performing at grades C to A*. It was a pleasure to see many candidates demonstrating an excellent grasp of the concepts ideas and knowledge required for the exam. Clearly most candidates were well prepared for the exam and took the opportunity to show their knowledge and understanding. In general candidates made good use of time with little evidence that they ran out of time. There was some evidence that more candidates are being entered who would be better suited to the foundation tier.

A fairly common issue was apparent in the candidates understanding of units. In many cases they were not aware of the correct units for a quantity, and where an awareness of units could help them select answers there was clear evidence that this was often not a happening e.g. question 4(b).

There was some evidence to suggest that candidates were assuming that the number of marks (given in square brackets at the end of each question) indicated how many answers were required, see questions 7c, 8aii and 8b. This was NOT the case on higher papers.

Comments on Individual Questions

1 a This question was common with the foundation paper. Nearly all candidates answered this part correctly.

b The most common errors were ‘gravity’ instead of ‘friction’ in the first sentence and ‘reaction’ instead of ‘interaction’ in the third sentence. Most candidates correctly gave ‘opposite’ in the second sentence.

2 a Most candidates correctly answered part (i). More errors occurred in part (ii), usually involving misreading values from the graph or failing to look at the change in distance and time and using the values at the end of the middle period instead.

b In part (i) the common error was to calculate the momentum, either before or after, but not the change in momentum. Part (ii) was rarely answered correctly; most marks were gained for the unit, ‘N’. Many candidates did not realise a numerical answer was required and commonly answered ‘friction’. In part (iii) weaker candidate suggested that ‘there is more time for force to be absorbed’, stronger candidates who did not consider the situation carefully suggested ‘the change in momentum will be less’ the correct answer was ‘the force x the time always equals the change in momentum’

3 a By far the most common error in part (i) was ‘four times’ instead of ‘double’ suggesting that candidates were not recognising that the velocity in kinetic energy is squared. In part (ii) more candidates correctly identified the effect of halving the mass as halving the kinetic energy. The most common errors were ‘doubling’ and ‘a quarter’.

3 b Nearly all candidates correctly calculated the numerical value of 60,000. However, far fewer were able to identify the units as Joules. Nm was accepted as an alternative unit. The most common error was N/m, with occasional appearances of kJ (an answer of 60 kJ gained both marks).

4 a This question was common with the foundation paper. Most candidates correctly linked charge flow and energy transfer. Amongst candidates who gave incorrect answers, the errors were equally divided between the two distracters, where energy transfer increased voltage and all energy transferred heated the water.

b Errors seemed to be equally divided between the incorrect answers. A surprising number of candidates showed little awareness of units. This was demonstrated by the significant number that choose calculations giving different numbers of the same unit eg 6J and 6000J.

c The most common errors were 10W and 24W. There was some evidence that candidates thought the mains supply voltage was still 240V, as opposed to the correct value of 230V.

5 a In part (i) 'transformation' was by far the most common incorrect answer. In part (ii) most candidates could identify the wave form associated with a weaker magnet and an iron core, and many correctly chose the waveform when the magnet spun faster. However, few candidates correctly interpreted the increased number of coils. Many candidates included each of the letters once, this may be because they had not read the rubric which stated that each letter could be used 'once, more than once or not at all'.

b The most common error was 'resistance' in place of 'potential difference' in the first sentence. Nearly all got 'opposite' correct in the third sentence. Most correctly used 'negative' and 'positive' in the fourth sentence, however a surprisingly large number thought electrons were positive.

6 a This question was common with the foundation paper. In the first sentence the most common error was 'frequency' closely followed by 'wavelength'. Many candidates could link 'bright' with 'constructive' interference or 'dark' with 'destructive' interference, however fewer realised that the 'bright' combination was needed.

b Nearly all candidates correctly identified the description of diffraction.

7 a This question caused most candidates problems. Some confused frequency and amplitude modulation. Others did not appear to be aware that audio frequencies are less than radio/carrier frequencies. Many appeared to be simply guessing.

b Most candidates correctly applied the equation, but it was very common for the frequency unit not to be read properly, treating MHz as Hz, hence getting 1.5×10^6 m rather than 1.5 m.

c Most candidates were choosing correct statements. By far the most common error was to only select 2 statements instead of the 3 correct statements. There was no particular correct statement selected less than the other correct statements. This may be because candidates assumed that the 2 marks available meant two ticks were required. This is NOT always the case on higher tier papers.

8 a Nearly all candidates answered part (i) correctly, the occasional error was usually the reflection diagram D. In part (ii) Few gave both A and C. Most gave a single letter, commonly diagram A. This may have been candidates reading too much into the number of marks available [1], despite plural, diagrams, asked for in the question.

b As with 7(c) Most candidates were choosing correct statements. By far the most common error was to only select 2 statements instead of the 3 correct statements. There was no particular correct statement selected less than the other correct statements. This may be because candidates assumed that the 2 marks available meant two ticks were required. This is NOT the case on higher tier papers. When an incorrect statement was chosen it was most commonly ‘the type of wave’.

A333/01 – Twenty First Century Science Physics A (Ideas in Context plus Module P7) Foundation Tier

General Comments

Generally candidates performed well on this paper. Most appeared to be entered for the correct tier with an absence of very high marks suggesting that Centres are entering more C candidates for the higher paper giving them access to higher grades.

Candidates should be aware that the marking is done from scanned images of their scripts. Consequently, if candidates change their minds, any alterations must be made clearly and unambiguously. This was done more clearly than in the past, candidates and Centers should be congratulated for this.

The level of difficulty was appropriate for the ability range and most questions were accessible to candidates across the ability range. The majority of candidates generally performed well and marks were awarded across a wide range, demonstrating appropriate differentiation. Scores typically ranged from the low teens to the high thirties.

Most candidates correctly followed the instructions in the questions and most made their responses appropriate to the number of marks available. Some, however, did not read the questions carefully enough.

All candidates seemed to have made good use of their time. There was no evidence of candidates running out of time.

Question one (14 marks) on this paper is based on the pre-release article that centres received well in advance of the exam. Centres should be aware that this article can and should be used in preparing candidates for this exam.

Comments on Individual Questions

1 ai This question was missed out by a significant minority of candidates. There was evidence that some candidates had not seen the different graphs before and a large number did just draw a straight line going up from the origin or down from the origin to illustrate the difference.

aii A significant minority of candidates repeated wrong answers from the article.

bi The vast majority of candidates got this mark.

bii It was very pleasing to see that a significant proportion of the candidates got 3 marks for this question. Of those that didn't there were a large number gaining credit of one mark for either the formula or numbers indicating they knew the formula. Candidates should still be encouraged to show their working out clearly so that credit can be given if the final answer is not correct. There was also still evidence that some candidates do not have access to electronic calculators.

1 ci Candidates generally scored well on this question with a common wrong answer being "kinetic energy" and "potential energy". Gravity was given credit but not gravitational potential energy.

cii This question was not answered well by the majority of candidates. The most common wrong answers involved candidates saying what was happening to the forces "the driving force increases and the counter force decreases" or "as the driving force increases so does the counter force" but didn't directly compare one force to the other, and so could not gain credit.

d This question was common to the higher and foundation papers. It was not answered well. Many candidates did not draw a circuit diagram, they drew a picture of the tram. Of those that drew a circuit diagram a significant number didn't use the correct symbols for resistor and power source.

e Again many candidates scored well on this question but those who didn't get the correct answer didn't show their working. Although in this case only one mark was available and therefore no marks were available for working out.

Questions 2 to 5 were based on the P7 unit content and accounted for 41 marks.

2 ai This question was answered very well by many candidates. It was pleasing to see that centres have concentrated on this area and candidates have been well prepared. Of those who didn't get full marks, "protostar" was the label most candidates got wrong followed by "cloud of gas". The later stages of the stars cycle were nearly always correct .

aii Again this question was answered very well, with most candidates knowing supernova and many more getting full credit with neutron star as well.

b This question was answered very poorly. The vast majority of candidates gave an answer of core or mantle suggesting a confusion with learning the parts of the Earth. Being able to label, and know the function of, parts of the sun is relatively new and as such candidates and centres are taking time to fully grasp it.

ci This was answered well and most candidates gained credit for this question.

cii This was not answered as well , with helium being the most common wrong answer. The answer of uranium was also common suggesting a confusion of fission with fusion.

ciii Most candidates gained the mark for carbon here which was pleasing, far fewer didn't get the oxygen mark with answers ranging from hydrogen to uranium.

civ The majority of candidates gained one mark which was the high pressure mark. The link with iron being a large element was not made as often and subsequently the second mark was only gained by a minority of the candidates.

cv The vast majority of candidates gained this mark and this was very pleasing.

3 ai Many candidates got the distance of the stars the wrong way round and said the larger the angle the larger the distance, although there was still a large minority who gained the mark.

aii A surprisingly large number of candidates didn't get this mark and as such centres should ensure that candidates are fully aware of how to calculate the distance to stars using parallax angle measurements.

3 b Candidates generally gained the mark for the disadvantage here but were less clear about the advantage with general comments about ”seeing more” and “being closer to the stars” being common wrong answers.

ci The vast majority of candidates gained the mark here and those that didn’t tended to be reading from the wrong axis.

cii Again most candidates gained one mark but missed the second one, usually by not writing down the units.

di This question was found to be very difficult by the candidates with almost none gaining the mark. The idea of comparing observed brightness to intrinsic brightness is fundamental to the measurement to distant stars and galaxies and this is what this question was getting at.

dii Most candidates gained the first mark of this question but not the second. The temperature of the star was the mark that was missed the most.

ei This question tended to be answered well by candidates and centres should be congratulated.

eii Very few candidates gained the mark for light years here and answers such as miles cm and km were common.

4 This question was common to both tiers and candidates found it was difficult but made a good effort to answer most of the questions.

ai was answered well but common mistakes included “a better view” and “better weather”. “Pollution” that was not linked to the air in some way was not allowed credit.

aii This question was answered well and this was pleasing.

aiii The vast majority of candidates didn’t get this mark. Either they had the objective lens as more powerful or they discussed the focal length of the lens.

b Many candidates quoted astronomical reasons here where the question specifically asked for none astronomical reasons. This was not given credit. The three main areas for which credit was given were with the cost of the project the impact on the local community (environmental or social) and the working condition for the workforce.

ci Some candidates did get these marks but many drew a lens diagram rather than a curved mirror. Some candidates did draw a clear diagram of a reflecting telescope that was given full credit.

cii Generally candidates gained the first mark for collecting more light but then failed to go on a link this to seeing further or seeing brighter stars.

d Candidates usually gained the first mark here but often failed to go on and give a second reason. A common mistake was to say “reduce human error”. The candidates gained the Quality of Written Communication mark for having two relevant ideas clearly ordered in their answer.

e Candidates tended to gain the mark for sharing the cost of the project but were less clear when it came to sharing expertise and resources.

A333/02 – Twenty First Century Science Physics A (Ideas in Context plus Module P7) Higher Tier

General Comments

The Higher tier paper is designed to test the knowledge and skills of candidates performing at grades C to A*. It was a pleasure to see many candidates demonstrating an excellent grasp of the concepts, ideas and knowledge required for the exam. Clearly most candidates were well prepared for the exam and took the opportunity to show their knowledge and understanding. In general candidates made good use of time with little evidence that they ran out of time.

However there was evidence to suggest that a significant minority of candidates were inappropriately prepared for the higher tier paper. In particular some appeared unfamiliar with specification content specifically identified as higher tier and had difficulty expressing their ideas clearly in scientific language.

Questions that required simple calculations (momentum, power, GPE, distance in parsec) or reading from graphs were done well.

The questions on the pre-release material were not done well; many candidates did not seem well prepared for this section.

Comments on Individual Questions

1 This question was based on the pre-release article. Part (a) and (b) were common with the foundation paper. A surprising number of candidates were not well prepared to answer questions on the physics referred to in the pre-release material.

a In general this was not answered well. A large number of candidates lost marks by drawing resistors with diagonal lines (with no arrow) through them or drawing fuse symbols; circuits in general were drawn rather poorly, with few candidates using rulers for example. Others did not complete all instructions, missing off the labels. and a few did not understand series and parallel circuits. A lot of pictures were given - not circuit diagrams.

b Most candidates got this mark, however a large minority gave ‘4000,000’ as the most common incorrect answer using the velocity in km/h.

c Very few candidates gained three marks. Most missed "induced voltage" (writing "current" instead). Many candidates failed to read the question carefully and did not draw a graph, sketching the arrangement of equipment instead. Quite a large number of candidates talked about a magnet moving through a coil, gaining marks, but missing the idea of rotation. A number of candidates described transformers. In part (ii) many candidates did not appear to understand why a.c. is used. Some picked up 1 mark, often for “easier to transmit” although lack of precision with language meant many used words like “travel/transport/send” which were not creditworthy. Many had no idea, with a significant number thinking “a.c. could go to many places whist d.c. could only go to one.”

1 d Most candidates achieved the Gravitational Potential Energy (GPE) part of the calculation, and then stopped. Generally, candidates who managed to equate Kinetic Energy and GPE achieved 3 or 4 marks, as some forgot to take the square root at the end. In part (ii) Most candidates realised that friction/air resistance was an issue (even those who did not complete the calculation) however some were too imprecise in their language "there were other forces..." etc. Also frequently seen were “the speed used was the final speed and not the average” or “the tram was full”. The most common correct answers were “friction” and “air resistance”.

2 This question was common with the foundation paper.

a Most candidates correctly stated that light or air pollution would be a problem, weaker candidates simply said “pollution” without qualification. Nearly all candidates correctly calculated the power, in part(ii). However there was a lack of understanding of significant figures demonstrated, with many writing down 10dp. In part (iii) many students said the eyepiece lens “was lower power”. Weaker/stronger were also common answers.

b Most candidates gave correct answers, some stated simply "cost and social factors" or gave specific examples of these. Most common incorrect answers related to astronomical reasons (light pollution, interference etc).

c Most candidates picked up both marks, in part (i) although the quality of diagrams was poor, for example a curved line for a mirror. Some candidates drew the whole telescope including eyepiece, gaining marks, but showing a lack of focus on the question.

In part(ii) most of the candidates realised that more light would be collected, although the use of language was imprecise. A few candidates tried to justify the lack of diffraction, but showed a lack of knowledge of the wavelength of light, stating that the mirror had to be wider than the wavelength.

d Candidates tended to discuss control/comfort or accuracy, but rarely both. Candidates who talked about tracking were most likely to gain full marks.

e Most candidates gained the cost mark, fewer managed to gain the expertise mark. A large number of candidates still make the mistakes of suggesting “being able to use a particular site” or the sharing knowledge gained idea.

3 a Most candidates knew red giant and white/black dwarf, (although there were a number of red dwarfs). Fewer picked up the mark for nebula and even fewer knew protostar. A small number wrote proton star.

b Candidates lost marks for missing the "red" from red super giant. Supernova and black hole were the usual combination. Some candidates wrote "or" on the last arrow, giving supernova --> black hole --or> neutron star.

c Candidates who knew that the answer here was red giant picked up marks in the next section. Those who didn't tended to just guess the answers to the elements. A number included hydrogen or helium in both the answers to part(ii) and part(iii).

3 c In part (iv) candidates had problems linking ideas. Candidates had poor understanding of the conditions and processes (often candidates mentioned electrons or protons and neutrons attracting because of their charges). Some talking about electrons in the nucleus (not many quoted the correct components) and chemical reactions. Many candidates just repeated material from the stem of the question. However some gave clear and concise answers, many of these answers went well beyond GCSE level, including descriptions of the role of strong nuclear force as well as electrostatic repulsion.

4 a By far the most common error in part (iii) was the idea that the Hipparchus satellite could make better measurements because it was closer to the stars.

b Nearly all candidates correctly read the value from the graph in part (i). In part (ii), not linking the graph to the luminosity was a common error. Few got the 'compare' mark and a lot did not know the meanings of 'observed brightness' 'luminosity' and 'intrinsic brightness'.

c Some candidates were well prepared and were able to answer this question fully and concisely. Others did not seem aware of the debate, and misunderstood what Hubble did. A few re-stated their answer to the previous question in their answer. Others thought it was about Hubble's constant, speed of recession etc.

A219, A220, A229, A230, A329, A330, A339, A340 – Skills Assessment

Specification	Unit Code	Skills Assessment
Science A	A219/01	Practical Data Analysis and Case Study
Additional Science A	A220/01	Practical Investigation
Biology A	Either A229/01	Practical Data Analysis and Case Study
	or A230/01	Practical Investigation
Chemistry A	Either A329/01	Practical Data Analysis and Case Study
	or A330/01	Practical Investigation
Physics A	Either A339/01	Practical Data Analysis and Case Study
	or A340/01	Practical Investigation

Introduction

The scale of the moderation operation continued to be very large this year with 1000 different Centres submitting work for more than 225 000 candidate entries across all specifications. It appears from discussions with people attending INSET that the Principal Moderator's Report for 2008 has not always been seen and read. This report will still be available online at www.ocr.org.uk and some of the comments and guidance have been repeated again in this report. The Skills Assessment component of each of the above specifications is weighted at 33%. With this in mind it did appear on occasions that Centres were not always giving sufficient time for their candidates to develop the necessary skills, knowledge and understanding of Ideas about Science to show what they could do under assessment conditions.

Structure of the Report

Vertical black lines in the margin throughout this report highlight important areas of concern, advice and guidance by the moderating team.

This report is divided into the following sections:

- Administrative Aspects
  - General Comments
  - Type and Context of Work appropriate for the Separate Sciences
  - Practical Work
  - Supervision and Management of Coursework
  - Assessment and Marking Framework
  - Marking Strands B and C in Case Studies
  - Marking Strands I and P in Data Analyses and Investigations
  - OCR Cover Sheet for Candidates' Work
- Data Analyses
- Case Studies
- Practical Investigations
- Final Comments

Administrative Aspects

General Comments

Communication between moderator and Centre is a very important part of the moderation process. This year, moderators sent an early introductory letter to Centres to establish an e-mail contact between the person responsible for the coursework sample and the moderator. A simple checklist was also provided to help Centres ensure that everything that was needed was included in the coursework package. These extra measures helped to improve the efficiency and effectiveness of the whole process for those Centres who responded appropriately. However, there were still a significant number of Centres who did not send the mark lists and the samples promptly, therefore slowing up the moderation procedure.

The best Centres followed this checklist but too many Centres still did not include any supporting material that had been given to candidates. In particular, details of how each of the tasks used for assessment had been introduced and presented to candidates were often not provided. This lack of information did, on occasions, have a significant effect on the marks that moderators could support, leading to mark adjustments in some cases.

A significant minority of Centres did not appear to give enough care and attention to administrative aspects to ensure that their candidates received the correct total marks and for the moderation to proceed smoothly. This caused numerous problems for the moderating team given the short timescale for the completion of the moderation process. For example, transcription errors, mark changes after internal moderation not being carried forward to the MS1 sheets, misunderstanding of how to calculate the Strand mark, poor annotation showing where the marks were awarded, and provision of little information about internal moderation procedures. Too often there was little or no indication of how marks had been awarded. The minimum notation acceptable is to use the assessment criteria codes, e.g. Ib)6, at the appropriate point in candidates' work. For Case Studies, the better Centres provided further commentary. Suitable annotation makes it more likely that the moderator will be able to support the mark awarded. Effective internal moderation ensures that candidates are placed in the appropriate order of merit. If the order is felt to be unsound because marking is erratic, the Centre may be required to re-mark all of the work.

Type and Context of Work appropriate for the Separate Sciences

Following guidance from the Joint Council for Qualifications (JCQ), coursework can be submitted for as many specifications as it is valid for. This means that it has to match both type (e.g. Data Analysis and Case Study or Practical Investigation) and context (i.e. Biology, Chemistry or Physics) as appropriate for the specification concerned. A 'Notice to Centres' was sent to all Centres in January 2008 and again in November 2008 explaining these requirements. It was disappointing that a number of Centres did not meet these requirements and alternative coursework had to be requested. If there was none available then a downward adjustment to the marks was applied. If the same piece of coursework is submitted for more than one specification then it must be photocopied and put into the appropriate coursework sample package to the moderator. Many Centres did not help the moderation process work efficiently in this way.

Practical Work

The Data Analysis and Investigation must involve candidates having personal first hand experience of collecting data in a practical experiment. Computer simulations or sole use of teacher demonstrations are not acceptable substitutes. **Coursework which does not fulfil this requirement cannot be submitted for assessment**.

In the Investigation, marks awarded for Strategy (S) and Collecting Evidence (C) Strands must be based on an individual's contribution and not on a shared approach or shared class data or data from other secondary sources. Those few Centres who did not follow these requirements put the marks of their candidates at severe risk.

In the Data Analysis, an individuals' data can be supplemented with additional data from secondary sources to enable assessment of Strands I and E.

Supervision and Administration of Coursework
There was evidence that some coursework from a minority of Centres had been reviewed and annotated by teachers giving candidates specific guidance about how to improve their marks. This is not acceptable practice. The Joint Council for Qualifications (JCQ) have published appropriate guidelines which are available in all schools

www.jcq.org.uk/attachments/published/315/ICE%20Coursework%202007%20FINAL.pdf

The following quotes are from this document:

"Teachers may review coursework before it is handed in for final assessment. Provided that advice remains at the general level, enabling the candidate to take the initiative in making amendments, there is no need to record this advice as assistance or to deduct marks. Generally one review would be expected to be sufficient to enable candidates to understand the demands of the assessment criteria."

"Having reviewed the candidate's coursework it is not acceptable for teachers to give, either to individual candidates or to groups, detailed advice and suggestions as to how the work may be improved in order to meet the assessment criteria. Examples of unacceptable assistance include detailed indication of errors or omissions, advice on specific improvements needed to meet the criteria, the provision of outlines, paragraph or section headings, or writing frames specific to the coursework task(s)."

"Once work is submitted for final assessment it may not be revised: in no circumstances are 'fair copies' of marked work allowed".

Those Centres who used detailed writing frames, whilst helpful for lower achieving candidates, appeared to restrict the opportunities for those higher achieving candidates.

Assessment and Marking Framework
The assessment framework is the same whether marking the Data Analysis, Case Study or Investigation. Skill areas are divided into Strands; within each Strand there are either two or three Aspects of performance represented as rows in the coursework cover sheet. Each Aspect of performance should be considered in turn, comparing the piece of work first against the lowest performance description, then each subsequent higher one in a **hierarchical** manner until the work no longer matches the performance description. Where performance significantly exceeds that required by one description, but does not sufficiently match the next higher one, the intermediate whole number mark should be given if available. Thus, the level of performance in each Aspect is decided.

For example in Strand E

Strand E				
Aspect of performance	**Marks**			
	2	**4**	**6**	**8**
(a) evaluation of procedures				
(b) reliability of evidence		Performance descriptions		
(c) reliability of conclusion				

There was a tendency for some Centres to award marks on the basis of candidates matching one high level performance description without ensuring that the underpinning descriptions had also been matched. A few Centres just counted the highest match for any Aspect to arrive at the

strand mark. Intermediate Aspect marks of 1, 3, 5 and 7 are awarded where performance exceeds that required by one statement, but does not adequately match that required by the next. Where it is not possible to support marks in a particular Aspect, a mark of zero must be awarded.

The Strand mark is determined by averaging the Aspect marks (including any zeros) and rounding to the nearest integer. A number of Centres are still not following this procedure and are being required to re-mark all their candidates' work.

E.g.

Marks for the three aspects in a strand	Formula to be applied	Mark to be awarded for the strand
(a) = 4, (b) = 4, (c) = 3	[(a)+(b)+(c)] / 3	= 3.66 round up = 4
(a) = 3, (b) = 4, (c) = 3	[(a)+(b)+(c)] / 3	= 3.33 round down = 3
(a) = 4, (b) = 3, (c) = 1	[(a)+(b)+(c)] / 3	= 2.66 round up = 3
(a) = 3, (b) = 3, (c) = 0	[(a)+(b)+(c)] / 3	= 2.0 = 2
(a) = 2, (b) = 3, (c) = 0	[(a)+(b)+(c)] / 3	=1.66 round up = 2

This approach provides a balanced consideration of each aspect of performance involved in each Strand and allows the marker to build up a profile of strengths and weaknesses in the work. Comparison of teacher and moderator judgements in each Aspect allows easy identification of where a Centre marks too severely, too leniently or where marking is inconsistent. This allows moderators to make far more constructive reports back to Centres.

Marking Strands B and C in Case Studies

There are only two Aspects in Strands B and C in the Case Studies and, in some cases, a professional judgement has to be made when arriving at the Strand mark, for example if 4 marks are awarded for B(a) and 3 marks for B(b). From experience in these cases, it is often best to consider both Strands B and C together when arriving at the final Strand mark for each. For example, if B(a) = 4, B(b) = 3 and C(a) = 4, C(b) = 3 are awarded, then it would be appropriate to award B = 4 by rounding up and C= 3 by rounding down (or vice vers(a) for a total of 7 marks for these two Strands taken together.

Marking strands I and P in Data Analyses and Investigations

In a few instances, dotted lines on the assessment scheme are used to indicate alternative ways of obtaining credit and a number of Centres, although fewer than last year, did not seem to appreciate what to do in these circumstances. Aspect (a) of Strand I and Aspect (b) of Strand P are sub-divided in this way. This has been done to allow increased flexibility, so that the scheme can be applied to a wider variety of different types of activity.

Strand I Aspect (a) involves awarding credit for processing the data which has been collected to display any patterns. This may be done either graphically or by numerical processing, whichever is most appropriate in a particular Data Analysis or Investigation. If there is some evidence for both approaches, then both should be marked and **the better of the two is counted but not both marks**. Some Centres counted both marks which produced an incorrect aggregate for the Strand.

E.g.

Strand	Aspect of performance	0	1	2	3	4	5	6	7	8	Strand mark
I	Graphical processing of data **or** Numerical processing data								✓		6
	Summary of evidence							✓			
	Explanations suggested							✓			

Strand P Aspect (b)

Strand P in Investigations is made up of three Aspects:

P(a) describing the work planned and carried out
P(b) recording of data
P(c) general quality of communication.

Aspect (b) is sub-divided into three sections to cover a variety of types of investigation.

	2	4	6	8
P(b)	Major experimental parameters are not recorded. Some data may be missing.	Most relevant data is recorded, but where repeats have been used, average values rather than raw data may be recorded.	All raw data, including repeat values, are recorded.	All relevant parameters and raw data including repeat values are recorded to an appropriate degree of accuracy.
	Labelling of tables is inadequate. Most units are absent or incorrect.	Labelling is unclear or incomplete. Some units may be absent or incorrect.	All quantities are identified, but some units may be omitted.	A substantial body of information is correctly recorded to an appropriate level of accuracy in well-organised ways.
	Observations are incomplete or sketchily recorded.	Recording of observations is adequate but lacks detail.	Observations are adequate and clearly recorded.	Observations are thorough and recorded in full detail.

The first row is concerned with recording quantitative data (e.g. times, voltages, volumes). The second row deals with the use of conventions and rules for showing units or for labelling in tables etc. The third row deals with the recording of qualitative data (e.g. colours, smells). Most investigations are of a quantitative nature and will provide evidence for the first and second rows. In these cases, the Aspect mark will be determined by averaging the mark in these two rows only, ignoring the third row completely. For those rare investigations which include qualitative evidence but no quantitative evidence, the mark for Aspect b should be based on the average of the second and third rows only. Where averaging results in half marks, professional judgement should be used to determine the best fit mark of the two alternatives. Once the mark for Aspect (b) has been decided, it can be combined with the marks for (a) and (c) to provide the average and so the best fit mark for the Strand.

For example, in an Investigation providing **quantitative** evidence

Aspect of performance			**Strand P mark**
P(a)	7	7	**6**
P(b)	(i) 6 (ii) 4 (i(ii) n/a	5	
P(c)	7	7	

Sub-dividing Aspect (b) in this way allows flexibility in marking the recording of data without allowing Aspect (b) to dominate the mark for the whole strand.

All marks are recorded on the OCR cover sheet which is attached to candidates' work. A number of Centres did not use the latest format of the OCR cover sheet or in a very few cases did not use a cover sheet at all. An example is shown below:

GCSE

Additional Science A

OCR GCSE J631 Twenty First Century Science Unit A220

Coursework Cover Sheet for Investigation

Centre No:		Centre Name:	
Candidate No:		Candidate Name:	

Put ticks in the boxes (one per row) to indicate the mark matched by the candidate's work for each aspect of performance. Record the mark awarded for each Strand and the final total mark. The remaining columns should be left blank.

		Title (as shown on work): Rate of reaction thiosulfate and acid												
Strand	**Aspect**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Strand Mark**	**Leave these columns blank for the moderator**		
												Mod	**T/L**	**Moderator comment**
S	**a**								✓		**6**			
	b							✓						
	c						✓							
C	**a**								✓		**7**			
	b								✓					
	c									✓				
I	**a**									✓	**5**			
	b					✓								
	c					✓								
E	**a**						✓				**4**			
	b							✓						
	c	✓												
P	**a**							✓			**6**			
	b	n/a							✓					
	c							✓						
Total mark for the Investigation											**28**			***A completed copy of this form must be attached to the work of each candidate in the sample requested by the moderator.***
Mark difference (Moderator Total – Centre Total)														

Data Analysis

General Comments

The Data Analysis task provides the opportunity to assess candidates' understanding of Ideas about Science, particularly IaS 1, 2, and 3. Those candidates who understood and used the language and concepts related to IaS, such as 'correlation and cause', 'outliers', 'reliability', 'accuracy', 'best estimate', and 'real difference' found it easier to match the performance descriptions of the criteria and so gain higher marks.

The majority of Centres clearly understood that in the Data Analysis task **candidates must have personal firsthand experience of collecting data by performing a practical experiment.** The data that candidates collect can be supplemented by further data from, for example, incorporating a class set of results. Work which is based purely on teacher demonstrations, computer simulations, given sets of results etc. is not acceptable. Many Centres used whole class practical activities as a basis for Data Analysis exercises and this clearly worked well. Therefore it is very important that Centres include details of how the task was presented to their candidates, e.g. briefing sheets etc. The higher attaining candidates included a description of their experimental method, their own results table and the class data set which made the marks awarded for evaluation easier to support. It is most important that candidates record and present the data that they have collected and not just plot a graph or do numerical calculations without any reference to the original data.

The same Strand I and E assessment criteria are used in Investigations and the same marks for I and E from Investigations can be submitted for Data Analysis in another specification providing that the context is appropriate. If this is the case, Centres are required to indicate this on the appropriate coversheet and also include copies of the work in both samples which are sent to the moderator, if the same candidate is selected. Many Centres used this opportunity to obtain the best marks for their candidates.

Data Analysis Tasks

There was a continuing variety of Data Analysis tasks seen by moderators which was very encouraging. These included:

monitoring pollution;	pulse rates and exercise;
osmosis;	enzyme studies;
stopping distances of bicycles;	breaking strength of hair;
stretching materials under load;	impact strength of plastic bags;
comparing thermal insulators;	resistance of a wire;
viscosity experiments;	voltage of different batteries;
rates of reaction;	objects rolling down slopes

Centres are encouraged to be innovative but must consider the science that might be required to explain any conclusion drawn by the candidates. As in all assessments of this type, Centres should match the task to the ability and expectations of the candidates involved.

Strand I: Interpreting Data

Ia): Most candidates analysed their data using bar charts or graphs to illustrate and process the data that they had collected, rather than carry out a numerical analysis. Centres must recognise that to award 7 or 8 marks, an indication of the spread of data must be shown **in addition** to the requirements for 6 marks. Candidates generally either plotted the averages with the appropriate range bars, or plotted all their raw data with a suitable key.

The following guidelines might help to clarify the assessment of Aspect (a) but it is not intended to be comprehensive and to cover all eventualities.

- Ia) 4 simple charts, bar charts
- Ia) 5 a dot-to-dot graph, or axes not labelled, or incorrectly plotted point(s), or poor quality line of best fit

- Ia) 6 graph with a line of best fit, correctly plotted points, correctly labelled and scaled axes.
- Ia) 7/8 accurately plotted graph including a line of best fit and evidence of awareness of uncertainty in data, e.g. range bars or scatter graphs.

It was pleasing to see that the majority of candidates repeated their measurements and included range bars on their graphs. However, in many cases graphical work was not of suitable quality for the marks awarded. For example, poor care in general presentation, incorrectly labelled or scaled axes, incorrectly plotted points and poor accuracy of the best fit line. Some candidates included range bars when plotting bar charts and were wrongly awarded 8 marks. At best, this approach might merit 5 marks. The same standards apply when marking computer-generated graphs, e.g. they must be correctly sized and scaled with appropriately sized plotting points. It is generally better for candidates to hand draw their own line of best fit.

Centres are reminded that only one single mark must be used for Ia), either that for graphical or that for numerical work (not both), when determining the overall Strand I mark. Further information about the award of marks for numerical approaches is contained in the 2008 Report.

Ib): The match to Ib)4, 'identifying trends or general correlations in the data', was well appreciated and most candidates could summarise the patterns in their data with a suitable qualitative statement. However, candidates were often given 6 marks with little evidence to support this award. Many candidates referred to 'positive correlation' (this only merits 4 marks) when they should have said 'Y is directly proportional to X'. Candidates should describe a quantitative relationship to ensure a secure match with Ib)6. For example, using and quoting the data to show, 'as the concentration is doubled the rate doubles', 'double the length of wire double the resistance', or the candidate calculates slopes/gradients and then states some formal or quantitative relationship between them and the variable studied. In some experiments this might not be so easy because relationships are changing. For example, in a study of the effect of temperature on the enzyme-catalysed decomposition of hydrogen peroxide, candidates might record the amount of oxygen produced at different temperatures in a given time, convert the data into rates and make appropriate comparisons before and after the optimum temperature.

Very few candidates matched the requirements for Ib)8. Candidates should review any limitations to their conclusions by considering such things as the scatter in the data, overlapping range bars between data points, 'real differences' and values of the best estimate and whether the best fit line can be accurately defined. Candidates who have derived a quantitative relationship should consider what effect the position of the best fit line might have if the scatter in the data is taken into account.

Ic): Many candidates introduced their experiment by describing all aspects of the background theory even if it was not all relevant to the particular experiment they were doing. Candidates are better served if they connect their conclusion directly with their scientific explanation. Most candidates could secure a match to Ic)4 by explaining their conclusion using scientific ideas. However, there was some very generous marking when matching to Ic)6 and Ic)8 in terms of the detail and quality of the scientific knowledge and understanding shown. In general terms, 5/6 marks would be expected to be awarded to an explanation at about the grade C standard and that at 7/8 marks of the grade A standard. Those candidates who used diagrams to supplement their explanation found it easier to access the higher marks.

Strand E: Evaluation

An essential feature of this course is to encourage candidates to consider the accuracy and reliability of the data that they collect. However, the majority of candidates only achieved between 3 or 5 marks for this Strand. Those candidates who used the appropriate IaS vocabulary and the knowledge and understanding of IaS 1 invariably achieved higher marks. Those candidates who used sub-headings such as 'Evaluation of Procedures', 'Evaluation of

Data' and 'Confidence Level of Conclusion' were more likely to focus on each area in turn and be more successful in their overall evaluation.

E(a): Candidates are expected to comment on any limitations or problems in their procedures that they encountered during their practical work and to describe improvements or alternative ways to collect their data. In many cases, comments were limited to human error rather than systemic experimental ones. The E(a)4 performance description is really the 'gatekeeper' to access the higher marks. Many candidates suggested possible improvements although they were not always of sufficient quality to be creditworthy, e.g. 'do it with a computer', 'repeat my measurements more times' and 'be more careful next time I do the experiment', without any justification or explanation. References to such things as better temperature control using a thermostat-controlled water bath in a rates experiment, or including a variable resistor in the circuit to keep the current constant in an electrolysis experiment, were more suitable and creditable suggestions.

E(b): Some candidates mentioned outliers without any direct reference to what particular result they were referring to. However, the majority of candidates generally identified a data point as an outlier either in the table of results or on the graph, although it was not always clear why a candidate had selected a particular result as an outlier. More candidates this year considered the range in their repeat measurements to give an estimate of reliability but few considered the general pattern in their results and closeness of their data to the best fit line, for example, as a basis for assessing accuracy. Candidates' attempts to explain anomalous results were often generously marked and it is important to mark the **quality** of what has been written and not the fact that just **something** has been written.

Higher attaining candidates made a decision about whether unexplained outliers should be included in the data and in ranges of repeat readings by simple numerical calculations. Some candidates used simple statistics such as variations of the Q test procedure to try and be more objective when rejecting suspect observations and relating to confidence levels.

E(c): Marks were often rather generously awarded and this aspect was poorly addressed by many candidates, although there was perhaps a slight improvement on last year. Candidates often just discussed the reliability of their data without really linking it to their conclusion and saying whether the uncertainty in their data is sufficient to have any significant effect on the conclusion that they have made.
For the award of 6 marks, candidates should bring together a discussion of the accuracy and reliability of their data and the precision of the apparatus they have used to establish a level of confidence in their conclusion. Further support for this can come from awareness in Ib) about the limitations in the conclusion. In addition for 8 marks, weaknesses in the data should be identified (e.g. a limited range or not enough readings at certain values, or degree of scatter too large or variable) and suggestions made indicating what further data could be collected to make the conclusions more secure for the particular variable under investigation. Some candidates used other data from secondary sources to support (or challenge) their conclusion.

Case Studies

General Comments
The purpose of the Case Study is to encourage candidates to use their knowledge and understanding of the Ideas about Science, particularly IaS 4, 5 and 6, to make judgements when presented with controversial issues which have claims and opinions for both sides of the case. There is still a great deal of evidence that many candidates are not being taught to use these skills when approaching their Case Studies. Where candidates were able to use the language and concepts related to IaS, such as 'peer review', 'replication of evidence', 'correlation and cause' 'reasons why scientists disagree', 'precautionary principle', 'ALARA', 'risks and benefits', 'technical feasibility and values', they found it much easier to match the performance descriptions of the criteria and so gain higher marks.

Case Studies are always best formulated in terms of a question to provide a focus in an area of controversy. For example, 'is nuclear power the fuel of the future?' rather than just 'nuclear power'. A question will encourage candidates to look for different opinions and views, and to consider the evidence base for the various claims and the reliability of sources of information that are used. There were many examples of candidates presenting a report describing a topic which was not controversial, or at least was not phrased in such a way that there were two sides to consider and compare. For example, what was apparently a debate regarding whether the use of nuclear power should be expanded sometimes resulted in a simple review of methods of alternative energy generation. This severely limited the number of marks available. The Case Study is a critical analysis of a controversial issue firmly embedded in a scientific context so that candidates can use their scientific knowledge and understanding and their understanding of IaS to produce a balanced account.

Many Centres provided a short list of Case Study titles for their candidates to choose from, thus allowing them to select one which is the most appealing on an individual basis. Some more unusual and inappropriate titles were also seen, e.g. 'do ghosts exist?, 'is it ethical to clone cyborgs?' and 'should football goal mouths have video cameras?'. Teachers must closely monitor their candidates' choice to ensure that it is appropriate and firmly embedded in a scientific context. This was often not the case for some of the lower achieving candidates in particular. Surprisingly, many candidates did not make full use of the relevant information and material in textbooks, often preferring to use material from the internet only.

Some examples of Case Study titles included this year included:

Aspects of diet e.g. Is obesity inherited?
Food additives – are they good or bad?
Should GM crops be allowed?
Should human cloning be allowed?
Are mobile phones bad for your health?
Is nuclear power the answer to our energy needs?
Should we spend more on developing alternative energy resources?
Is the MMR jab safe?
Is global warming natural or man-made?
Could life exist on other planets?
Does motor traffic cause asthma?
Should animal testing be allowed?
What killed the dinosaurs?

Assessment

In general, candidates continued to perform better in Strands A and D compared to B and C. Higher achieving candidates described the relevant science needed to understand their chosen topics and produced high quality, clearly structured, well resourced and illustrated reports involving critical analysis and individual thought with considerable personal input. It was this latter aspect of personal analysis and evaluation which often differentiated candidates in terms of level of performance. Lower achieving candidates relied too heavily on copying and pasting information from sources without the appropriate level of individual analysis and evaluation. Those reports, which were often presented simply as PowerPoint printouts, almost always lacked sufficient detail to access the higher marks.

It would be most helpful for moderation if more annotation or commentary was provided for each candidate in the sample selected so that the moderator could more easily identify the evidence to support the Centre's marks. In many cases, only the final mark awarded was recorded.

Strand A: Quality of Selection and Use of Information

There was some evidence of improvement in the marks awarded for this Strand compared to last year.

A(a): Candidates must use sources of information to provide sufficient evidence for **both sides** of their Case Study. They must select relevant extracts to quote directly and then, in their own words, explain what its relevance and importance is to the developing arguments in the report. If no sources are credited then a maximum of 1 mark will be allowed by moderators, unless annotation confirms that a suitable range of sources were used. Higher marks require that sources represent a variety of different views or opinions, but there is not a 'magic number' of sources which distinguishes 3 marks from 2; relevance and quality is more important than quantity. Many candidates who were awarded 4 marks often made reference to reliability but did not explain why they thought their sources were reliable. There were far too many references just to the 'BBC or Wikipedia so it must be reliable'. Those candidates who used the language and ideas from IaS 4, e.g. ideas about peer review, the nature of the source or the status of the author, invariably achieved higher marks.

A(b): The majority of candidates included a bibliography of sources at the end of their reports. Candidates who identified their sources using incomplete references, e.g. website homepages such as www.bbc.co.uk, could be awarded 2 marks. If only one or two incomplete references were given then one mark could be awarded and, of course, if no references were given then zero marks were appropriate. For 3 marks, candidates should include complete references to the exact url address of the webpage and, when referencing books, the title, author and page references should be provided. For 4 marks, it is expected that candidates include some information about the nature, purpose or sponsorship of the site.

A(c): Candidates were still not very good at clearly showing where sections of text were directly quoted. The fact that this acknowledgement is missing does amount to malpractice. Quoting from the JCQ document, 'candidates must not include work copied directly from books, the internet or other sources without acknowledgement or attribution'. Use of quotation marks, use of a different font, or colour highlighting were some of the methods used by the higher attaining candidates for this purpose. The higher attaining candidates also included references or specific links within the text to show the source of particular information or opinions by using, for example, numerical superscripts linking to references in the bibliography. Credit is given, not so much for the quotation, as for the editorial comment to explain why it was chosen, and how the candidate thinks it contributes to the arguments being compared in the study.

Failure to discuss reliability of the sources, failure to fully indicate and reference quotations and failure to indicate the relevance of the quotations selected in the study prevented many candidates from being awarded 4 marks in this Strand.

Strand B: Quality of Understanding of the Case

B(a): This aspect assesses candidates' ability to describe and explain the underlying relevant science and to recognise and evaluate the scientific evidence on which any claims are based (IaS 1, 2 and 3). The majority of candidates in the introduction to their Case Studies described the relevant background science. However, it was only the most able who could either link their scientific knowledge and understanding to the claims and opinions reported in their studies or extend the scientific knowledge base to more advanced concepts. Reporting was too often still at the 'headline level', simply repeating claims without looking behind the headline for the underlying science. From an assessment point of view it is useful to look at the appropriate pages in supporting textbooks, including the specifications, about Science Explanations and Ideas about Science, to give an indication as to what to expect before marking candidates' work. The most successful Case Studies are usually closely related to topics in the course and it can be taken as a general guide that 6 marks requires all of the relevant science covered in the specification. The 7th and 8th marks will come either for applying and integrating this correctly to the case, or for finding and explaining some additional science related to their Case Study.

B(b): This Aspect focuses on candidates' ability to recognise and evaluate the scientific evidence that any claims and opinions are based on. Most candidates were able to recognise and extract relevant scientific content and data in their sources and were awarded 4 marks.

Candidates who were awarded 6 marks referred to the evidence base of the various claims and opinions, e.g. an experiment, a collection and review of existing data, a computer simulation etc. Candidates obtaining 7 or 8 marks looked more critically at the quality of the evidence. They used terms like 'reliability' and 'accuracy' when considering data, they looked at the design of experiments and the issue of sample size and they also compared the reliability of data between sources.

Strand C: Quality of Conclusions

Where Strand A allows credit for finding information and Strand B for describing the relevant science and the evidence base, Strand C awards credit for candidates who provide individual input comparing and evaluating the evidence, considering its significance, importance and reliability and using their own judgement to arrive at a suitable conclusion on a controversial issue. There was evidence that many candidates were not using and applying their Ideas about Science, particularly IaS 5, sufficiently to warrant the higher marks in this strand.

Most candidates could sort the information that they had gathered into views 'for and against' and were awarded 4 marks. Higher attaining candidates started to compare similar aspects in both their 'for and against' list and were awarded 6 marks. The best candidates began to analyse, compare and evaluate the claims and opinions, describing their own viewpoint or position in relation to the original question and justifying this by reference to the sources and to the evidence that the claims were based on. Far too often the conclusion was limited and too brief. Alternative conclusions should be considered where appropriate and recommendations for action in the future should also be included.

Several candidates scored less marks than they were probably capable of, particularly in Strand C, because they simply chose to report information about their topic, without any real analysis of the scientific evidence and incorporation of personal decision making.

Strand D: Quality of Presentation

D(a): The majority of reports included headings and/or sub-headings (2 marks) to provide the necessary structure. There was a definite improvement in this Aspect and the higher attaining candidates included a table of contents and numbered the pages in their report (3 marks) to help guide readers quickly to particular sections. Those candidates who, in addition, presented a report which had a coherent, logical and consistent style were awarded 4 marks.

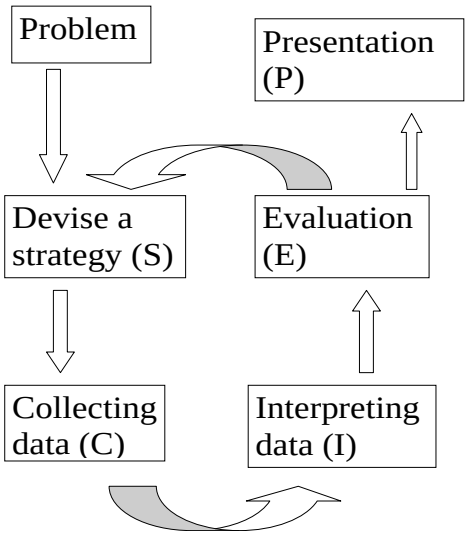
D(b): This aspect assesses candidates' ability to include suitable diagrams and graphics to clarify difficult scientific ideas and improve effective communication. However, too often the images were decorative rather than informative. If there are no decorative or informative images included, then zero marks is awarded. If one image is included, a decorative front cover or other low level attempt to add interest then 1 mark is appropriate. Two marks would be awarded for the inclusion of decorative images only or perhaps for the minimal use of informative images. Three marks would be given for including a variety of informative illustration, e.g. charts, tables, graphs, or schematic diagrams and 4 marks if this is fully integrated into the text, referred to and used. Too often downloaded images from the internet were not clear, too small and not referred to in the text.

D(c): The assessment of the use of scientific terminology and the level of spelling, punctuation and grammar was generally very fairly assessed by Centres.

Practical Investigations

There was more evidence this year that Centres were beginning to move away from the Sc1 approach to Investigations and develop a more open ended exploratory approach. The importance of candidates doing preliminary work was clearly being recognised and encouraged. However, information from Centres about how each investigation was introduced to candidates was very rarely provided in sufficient detail. This meant that moderators could not support some of the marks awarded leading to adjustments, particularly in Strands S and C.

A number of candidates, however, still followed the Sc1 Sc1 approach and used scientific knowledge to make predictions about the outcome of the investigation. The Twenty First Century Science model aims to give credit to candidates who process their results, look for patterns and then suggest explanations using their scientific knowledge and understanding. Very often candidates did not link their conclusions with their scientific explanations. Detailed explanations using relevant scientific theory are best left until they are needed in Strand I.



From an assessment point of view the 'performance descriptions' should be used to reflect the quality and performance of candidates' work rather than a formal/legalistic interpretation of particular words and phrases.

Rates of reaction, resistance of a wire and osmosis were still the most common investigations seen from Centres. However, there was evidence that other topics were beginning to be developed by the more innovative Centres, for example, stretching of plastics and other materials, exercise and fitness routines, efficiency of wind turbines, objects rolling down slopes or ski jumps, electrolysis and electromagnets.

Strand S: Strategy

Centres were generally matching candidates' work correctly up to the 6 mark performance description but higher marks were being very generously awarded.

The intention is to encourage a more independent approach to investigations and the mark awarded for the aspect, S(c), should reflect the 'value added' by the candidate, beyond the initial teacher stimulus. To justify high marks in S(c), candidates should show independent thinking in reviewing factors which might affect the investigation. Where candidates succeed in designing their own investigation, high marks can be awarded. Where some additional guidance is necessary, this should be annotated on the candidate's script and reflected in a lower mark. High marks cannot be supported by moderators unless the Centre has provided details of how the task was presented to candidates (e.g. copies of briefing sheets etc.) or comparison of different scripts in the sample shows clearly that candidates had freedom of choice between different approaches and apparatus. In too many cases moderators noted that candidates had identical ranges and values of the same variables, e.g. in the osmosis and resistance of a wire investigations the whole class used exactly the same number and values of concentration of solution or lengths of wire, without any further discussion or justification indicating that limited individual decision making had occurred, yet high marks were still being awarded. This necessitated a downward adjustment to the marks for S(c) in a number of Centres. If, for example, candidates were shown how to change the concentration of a solution they could then make up their own values rather than use the stock solutions which were often provided. Where candidates had been given the opportunity to show autonomy they performed well across many of the Strands. Some Centres opened up the rates of reaction investigation by allowing candidates freedom of choice between, for example, magnesium and acid, marble chips and acid, thiosulfate and acid, and, for methodology, collecting gases or measuring mass loss.

The importance of preliminary work cannot be over emphasised in the introductory phase of an Investigation and the appropriate amount of time must be given to this aspect. It is important for candidates to record their preliminary data and to use it to inform and develop the main experiment. Often preliminary work appeared to provide just a limited extra set of results and did not shape the Investigation in any way. Sometimes preliminary work was done but it was clear that candidates had not really understood why they were doing it.

Many candidates provided a list of appropriate apparatus for their Investigations but had not linked it to their preliminary work or indicated why it had been selected in preference to alternative apparatus. Those candidates who exerted some choice over the apparatus they used were in a better position to achieve higher marks in S(b) and also when evaluating their procedures and methods in E(a). Some candidates provided very simplistic explanations and Centres are reminded that it is quality of thought and response that is being rewarded and not just the fact that something has been written. Many Centres had provided a fixed, limited set of apparatus for candidates to choose from and this did not allow candidates the flexibility to try various approaches to obtain the best quality data set.

The complexity of a task, S(a), represents an overall judgement about the way a candidate has approached the task. Therefore two candidates doing the same Investigation might approach it differently and therefore achieve different marks. Complexity depends on such things such as the familiarity of the activity and method, the ease of observation or measurement (single or multi-step), the nature of the factors which are varied, controlled or taken into account, the precision of the measurements made and the range, accuracy and reliability of the data collected. Too often 7 or 8 marks were awarded for straightforward approaches to the task

Strand C: Collecting Data

It was pleasing to see that the majority of candidates used suitable ranges of the appropriate variable to study and appreciated the need to repeat their measurements to obtain a wide range of data. However, a discussion of the factors to control was often rather limited and only by inspection of the results table could any evidence be found. Higher attaining candidates described in detail how the factors had been controlled and monitored during the experiment. Weaker candidates often stated factors such as pH, surface area, current or temperature were kept the same but failed to explain how this was actually achieved or monitored.

Preliminary work is essential because if done properly it can allow candidates' access to the higher marks of 7 or 8 in Aspects (b) and (c). There was more evidence this year that candidates were doing preliminary work to establish the range of values of the appropriate variable to be used. However, some candidates did perform preliminary work but did not use the results to explain how it informed their main method. Centres are reminded again that it is the quality of response and its relevance that is rewarded and not just that preliminary work has been done, so 'jumping through hoops' is not sufficient criteria for success. Too often, candidates did not consider their results as they were being collected so that obvious outliers were either ignored, or included without comment in calculating average values. It was very rare to see a test repeated to check and obtain a more reliable result (C(b)).

From inspection of results tables and graphical work it was pleasing to see that candidates were taking more care and data was generally of good quality. There was little evidence of candidates performing preliminary work which involved making decisions about the type of apparatus, equipment and method to choose, to ensure the collection of the most accurate and reliable data (C(c)).

Strands I and E

In general candidates achieved their poorest marks in these two strands. There was a great deal of evidence to show that candidates did not link their conclusions sufficiently with their scientific explanations in I(c). For more details, see the comments in the Data Analysis section.

Strand P: Presentation

This Strand was generally fairly and accurately marked by Centres. Spelling, punctuation and grammar were sound and the majority of candidates' reports were well structured and organised. However, experimental methods were rather briefly described and lacked sufficient detail. Diagrams of apparatus were not always included and although data was generally accurately recorded and presented in appropriate tabular form, units were occasionally incorrect or missing.

The method of arriving at the mark for P(b) was often variable; more details can be found in the administrative section of this report.

Final Comments

All members of the moderating team recognise the considerable effort needed by Centres in assessing and presenting candidates' work for moderation. We would like to record our thanks and appreciation for a good job, thoroughly well done. However, there was a general feeling that there was an increase in errors seen in the transcription of marks and more care is necessary in this important area. Attending cluster group meetings and OCR INSET meetings both in- and out-of house, using the OCR consultancy service for checking marked scripts, and consulting and using the teacher guidance booklets on www.ocr.org.uk are all available methods to improve the awareness and understanding of the assessment procedure. It is highly advisable that staff have time during the year for internal standardisation meetings to share and develop expertise in the Science Department.

Grade Thresholds

General Certificate of Secondary Education
Physics A (Specification Code J635)
June 2009 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A*	A	B	C	D	E	F	G	U
A331/01	Raw	42	N/A	N/A	N/A	29	24	20	16	12	0
	UMS	34	N/A	N/A	N/A	30	25	20	15	10	0
A331/02	Raw	42	36	32	26	21	17	15	N/A	N/A	0
	UMS	50	45	40	35	30	25	23	N/A	N/A	0
A332/01	Raw	42	N/A	N/A	N/A	28	24	20	17	14	0
	UMS	34	N/A	N/A	N/A	30	25	20	15	10	0
A332/02	Raw	42	28	24	20	16	12	10	N/A	N/A	0
	UMS	50	45	40	35	30	25	23	N/A	N/A	0
A333/01	Raw	55	N/A	N/A	N/A	26	21	17	13	9	0
	UMS	100	N/A	N/A	N/A	60	50	40	30	20	0
A333/02	Raw	55	36	28	21	14	9	6	N/A	N/A	0
	UMS	100	90	80	70	60	50	45	N/A	N/A	0
A339	Raw	40	33	30	26	23	19	15	12	9	0
	UMS	100	90	80	70	60	50	40	30	20	0
A340	Raw	40	33	31	28	25	21	18	15	12	0
	UMS	100	90	80	70	60	50	40	30	20	0

A339/A340 (Coursework) - The grade thresholds have been determined on the basis of the work that was presented for award in June 2009. The threshold marks will not necessarily be the same in subsequent awards.

Specification Aggregation Results

Overall threshold marks in UMS (ie after conversion of raw marks to uniform marks)

	Maximum Mark	A*	A	B	C	D	E	F	G	U
J635	300	270	240	210	180	150	120	90	60	0

The cumulative percentage of candidates awarded each grade was as follows:

	A*	A	B	C	D	E	F	G	U	Total No. of Cands
J635	21.3	49.0	77.5	94.8	99.0	99.8	100.0	100.0	100.0	15349

15620 candidates were entered for aggregation this series

For a description of how UMS marks are calculated see:
http://www.ocr.org.uk/learners/ums_results.html

Statistics are correct at the time of publication.

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