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RECOGNISING ACHIEVEMENT

GCSE

Physics A

Twenty First Century Science Suite

General Certificate of Secondary Education **J635**

Examiners' Reports

June 2011

J635/R/11

Oxford Cambridge and RSA Examinations

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Physics A (Twenty First Century) (J635)

EXAMINERS' REPORTS

Chief Examiner's Report

The number of candidates entered for the Physics A specification has continued to grow this year, with most of the growth around the middle ability range.

It has been a pleasure to see the performance of candidates in this assessment session. As hoped the inclusion of more extended prose questions has provided candidates with more opportunities to demonstrate what they know.

It is clear that most centres have done a good job in preparing candidates for this style of paper, with most candidates now familiar with the different styles of question. Some issues are arising with the extended prose answers. Candidates are clearly being taught that they should always attempt to answer these, which is good advice. However many of the answers a poor scientific responses, for example many candidates are simply repeating the question or paraphrasing the question. This is rarely credit worthy and adds no value to the answers. Candidates need to give precise answers using correct scientific terminology. The amount of space provided for an answer is an indication of the depth of answer required. Answers that continue beyond the space provided are nearly always full of unnecessary and vague material. Being selective and concise and is an important feature of examination answers.

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 to either of two possible responses, where only one is correct, will not gain credit.

Other points that Centres should consider are that candidates should be encouraged to give an answer especially with the 'tick box' type of question. Failure to read the question as to how many ticks are required also caused problems for some candidates. Where candidates have to link boxes there were problems when candidates made a number of 'crossings out' and there were so many lines that it was difficult to decide which boxes the candidates wanted to indicate. This type of question also asks for 'straight lines' to be drawn from one box to the next; some candidates have rather strange ideas as to what constitutes 'straight' and consequently run the risk of losing marks because it is not always clear which boxes are actually connected.

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

General Comments:

This paper is designed for candidates operating in C – G grade range.

Two thirds of the marks on this paper were awarded to objective type questions and one third of the marks were awarded for 'free response' answers in which candidates had to write their own responses. In general candidates performed better on the objective type questions.

There was no evidence of candidates having time difficulties with the vast majority completing all questions in the time allowed. It was also clear that the vast majority of candidates were entered for the correct level paper

Comments on Individual Questions:

Question 1

(a) The neutron was well known but many lost marks indicating the photon instead of the proton.

(b) Although well answered by the better candidates there appeared a great deal of confusion between radioactive and radio waves.

Question 2

(a)(i) This was rather disappointingly answered across the whole ability range with only the minority giving 'a change in the nucleus' as a reason for energy release with 'reacting with oxygen' or 'burning to make fire' the most common errors.

(a)(ii) As a consequence of answers to part (a)(i) many candidates incorrectly started the sequence with a furnace; although many candidates had the correct three words in the boxes they were often in the wrong order.

(b) The vast majority of candidates knew carbon dioxide was the gas produced but some lost a mark because of incorrect formula, ie CO2 and CO^2 were deemed incorrect, carbon monoxide was often seen as an incorrect answer.

Question 3

This question proved a good discriminator. Most candidates knew that cancer was a possibility with fewer mentioning damage or change to cells or DNA, a minority knew that the time of exposure to radiation was important but the vast majority concentrated only on the effects of radiation rather than the factors that affected the risks

Question 4

(a) This was fairly well answered with 'radio waves' and 'microwaves' being the common wrong answers.

(b) This was reasonably answered with no one of the distractors being more common than any other.

(c)(i) The answers here were disappointing with 'intensity' being little known and all other alternatives appearing as answers.

(c)(ii) The 'speed of the photons' was a very common distractor with the majority of candidates getting one mark for the 'distance from the source'

(d) This proved a very good discriminator with very few weaker candidates giving the answer 'ozone', the alternative were many and various ranging from the Earth to greenhouse gases.

(e) This was a high scoring question with the vast majority of candidates being able to mention two methods of reducing risk and also how their methods reduced the risk.

(f) Again, this was answered well with the majority of candidates knowing why advice about the risk of sunbathing is often ignored.

Question 5

(a) This proved to be the most difficult question on the paper. Few candidates appeared to understand the word correlation and even if they mentioned a correct correlation they often contradicted themselves later. A considerable number said humans caused global warming but many did not use either of the words correlation or cause in their answer.

(b) Many candidates only gave two ticks and these concentrated on the warming aspect of global warming and ignored some places getting colder winters.

Question 6

This was a well answered question. In (a) the vast majority answered correctly about the continents fitting together but fewer gained the mark for similar fossils appearing on the different continents.

Question 7

Again, this was a well answered question with the majority of the candidates scoring 4 or 5 marks out of a possible 5.

Question 8

Most candidates knew what boxes moons and planets had to be connected to but comets and asteroids were less well known. Some drew two lines from a left hand box presumably so as to connect all the boxes on the right hand side. There were some considerably 'messy' answers with lines twisting and turning from one side to the other and a lot of crossings out so it was difficult to tell the answer the candidate wanted marking.

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

General Comments:

Generally candidates performed well on this paper. Although there are still a significant number of candidates who had difficulty accessing the questions and as a consequence performed badly. This suggests that some candidates may be being entered for the higher tier, for whom the foundation tier would be more appropriate.
The majority of candidates made a good attempt at the paper, with nearly all candidates attempting most questions. There was no evidence of candidates running out of time
In general the candidates coped reasonably well with the extended prose questions. There was clear evidence that centres had been working on how candidates dealt with extended prose questions. However for a significant minority the quality of the handwriting verged on the illegible.

There was evidence of some candidates not having access to electronic calculators in this exam. Candidates should be made aware that they are at a significant disadvantage in such circumstances.
Candidates need to be aware that, on the higher paper, the number of marks is not necessarily equal to the number of correct responses.

Comments on Individual Questions:

Question 1

This question was answered well by all but the weakest candidates. Many were able to give at least three or four correct marking points. All the points on the mark scheme were seen. Common errors included 'ionising cells', and 'radiation poisoning'. A few weaker candidates mentioned X-rays or wrote about the treatment of cancer in the hospital and some were confusing the Sun's radiation with radioactivity.

Question 2

In part (a) the most common wrong combination was A & D, the two isotopes of carbon suggesting candidates understood the term isotope, but where not aware that Uranium is a large atom. Most candidates were able to identify the positive ion in part (b).For part (c) by far the most common error was the combination: B & F, the two isotopes of uranium.
Many candidates correctly identified the alpha decay product in part (d); if wrong then the answer tended to be C or A.

Question 3

There were some excellent answers to part (a). However although many candidates had a general idea of how a nuclear reactor worked, their answers lacked detail and failed to score marks. Fission was described very loosely and some candidates mixed up ions, electrons or radiation for neutrons. The usual answer for coolant was to stop overheating. Candidates with some common sense but no real idea of nuclear reactors described the action of each part generally eg control rods control the chain reaction. Marks were mostly commonly scored for control rods absorbing neutrons and the chain reaction occurring in the fuel rods. Few candidates managed a correct calculation for part (b). From the working seen many candidates incorrectly used 4 half-lives and weaker candidates tried to multiply or divide the half-life by 8. In part (c) most answers were correct with a few candidates reversing the order. Weaker candidates placed alpha in the middle of the sequence.

Question 4

There were some good answers for part (a). Many got the correlation mark but didn't explain clearly enough the cause disagreement. Weak answers failed to use the words 'correlation' and 'cause'. For (b) very often only two boxes were ticked, which when correct only scored one of the two marks. Candidates need to be aware that the number of marks is not necessarily equal to the number of correct responses. The most common error was 'volcanoes erupting'.

Question 5

Part (a) was usually answered well. Weaker candidates would often include the non-electromagnetic, alpha or beta radiation. In part (b)(i) few candidates scored all three marks. The better answers got the first two marking points, but may not have clearly expressed the idea in terms of photons per unit area. Many candidates incorrectly explained the lower intensity by arguments involving photons losing energy as they travel, having difficulty travelling, being stopped or absorbed by the atmosphere. Part (b)(ii) was usually answered correctly the most common error was to reverse the 'more' and 'less'. In part (b)(iii) The location of the ozone layer in the atmosphere and its role in absorbing ultraviolet were usually known. However few identified the word reversible for the chemical changes. A very common error was to say that 'the Earth' was protected from ultraviolet radiation, as opposed to the living organisms on the Earth. For part (c), many answers reiterated the information in the question. Few answers were specifically aimed at the factors but gave information applicable to the sun beds. The most common correct answers that gained a mark involved exposure/dose/intensity to the ultraviolet radiation. ALARA & precautionary principle cropped up a number of times, but were inappropriate in this context.

Question 6

Moons & Planets were well known. However, if there were mistakes, they were usually with incorrect descriptions of asteroids & comets.

Question 7

Part a(i) was answered well by most candidates. The most common error was 'mountain chains' which was often given as a third response in addition to the correct two responses and hence only gaining 1 mark. Part a(ii) was correctly answered by most candidates; weaker candidates repeated answers from part a(i). For (b) very often only two boxes were ticked, which when correct only scored one of the two marks. Again candidates need to be aware that the number of marks is not necessarily equal to the number of correct responses.

Question 8

By far the most common error was to suggest that everything we know about the Universe comes from stars rather than light.. The second marking point (distance/speed) about the Hubble relationship was not often scored – some candidates referred to 'movement' instead of 'speed'. Weaker candidates linked distance with size or brightness. The final mark for the age of the Universe was usually correct, with 'million' being the most common error.

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

General Comments:

The paper was well received by candidates with most attempting all of the questions. Candidates appeared to have had a sufficient time allocation for the paper and there were few silly or irrelevant responses.

There was little evidence of entry to the wrong tier

A considerable number of candidates were unable to cope with the basic mathematics needed in some questions.

Legibility of responses was not as significant a problem for markers as has been on occasions in the past.

Comments on Individual Questions:

Q.1 The most common correct response was electric current = flow of charge and the most common mistake was electron = unit of current. A few candidates added a fourth line usually from the electron.

Q 2(a) Many candidates were unable to identify the variable resistor. Incorrect responses were about equally divided between the other components apart from LED which appeared rarely.

Q.2(b) Most candidates chose the correct response but several answered with 25W and a few with 0.04W.

Q.2(c) Most candidates knew that both battery and mains electricity can produce light and many knew that mains electricity was produced by a generator.The majority had difficulty with the rest of the question.

Q.3(a) Very few candidates scored full marks. Candidates scoring one mark usually knew the first and last rows but current in the circuit was often given as same in A and B.

Q.3(b) Many candidates scored two marks for 40 but few showed their working. The common error was to multiply V and I. Only a very small number of candidates stated the correct unit for resistance..

Q.4(a) Many candidates gave correct answers. A significant number of candidates scored 1 mark for stating 800/50 but then went on to calculate incorrectly. The most common error was 50/800. On occasion 4000 m/s was given for the speed of the car.

Q.4(b) Most candidates matched average speed correctly. The most common error was to link instantaneous speed to the definition of velocity. A minority of candidates linked all of the boxes.

Q.5(a)(i) Almost all candidates knew that arrow C was the weight and many could identify the driving force. Reaction and counter forces were often confused.

Q.5(a)(ii) Many candidates gave correct responses. It was noted that DB was often changed to AC suggesting candidates were reluctant to give the same answers in parts ii and iii.

Q.5(a)(iii) A and C was the most common error.

Q.5(b)(i) Very few candidates scored all the marks. There was no obvious pattern to the incorrect responses.

Q.5(b)(ii) Many correct responses. The most common errors were 1000/80 and the inability to cope with five zeros giving responses of 80 000 or 8 000 000.

Q.6(a) Wavelength was the most commonly correct but a some candidates ticked both A and C for this. There was confusion over what amplitude was and very few realised that frequency was not shown

Q.6(b) Very few candidates were able to answer this question correctly. All incorrect options were chosen with "bigger than" being the most frequently selected.

Q.6(c)(i) Most candidates were able to answer this correctly. The most common incorrect response was 20. Some candidates scored 1 mark for 60 x 3 and then went on to calculate incorrectly – an example of where showing your working is valuable.

Q.6(c)(ii) Many candidates gave no response to this question and others were very imprecise in their answers. Some answered in the affirmative and went on to try to explain the opposite. Inappropriate references were sometimes made to "electrons" and to "magnetic".

Q.7(a) This was answered very poorly with the majority of candidates getting only one of the words correct.

Q.7(b)(i) A minority of candidates drew the picture of circular waves spreading. Candidates often drew only one of the two features – circular or spreading out.

Q.7(b)(ii) Very few candidates knew this name (diffraction) and 'wave spreading' was sometime seen when candidates attempted to write down something they hoped would gain credit..

Q.8(a) A very large number of candidates were unable to identify analogue and digital signals. The option digital was often selected but in the wrong place and amplitude was frequently chosen incorrectly.

Q.8(b) Very few candidates were able to answer this over-lap question. The mark that was occasionally scored was for the idea that the shape was better retained in the digital signal, The quality of language used by candidates was often very poor in nearly all cases. Many said that digital had "less interference" or "picked up no noise". Many attempted a definition of digital. Others just said digital is better than analogue.

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

General Comments:

The paper was generally well attempted and produced a satisfactory spread of marks.

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

Many candidates seemed significantly less confident when tackling open response questions.

The level of difficulty was appropriate for the ability range and most questions were accessible to candidates. The majority of candidates generally performed well and there was satisfactory differentiation.

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

Candidates seemed to make better use of the formulae provided at the front of the examination paper compared to previous sessions. 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:

Question

1 This question on circuits was reasonably well answered by most candidates. Part (a) did not differentiate well, with even the most able candidates usually making at least one error in completing the table. The vast majority of candidates felt that the current in both circuits would be the same. In part (b) most students correctly calculated the value for resistance. Weaker candidates often showed no working (they were not penalised, provided they wrote down the correct resistance value) and also they often put the incorrect unit, most commonly 'A'.

2 This question examined ideas regarding series and parallel circuits. Weaker candidates struggled, particularly with the idea of potential difference. About half of the most able candidates got this completely correct with the other half usually picking up one out of the three available marks. It is important for centres to ensure that candidates are familiar with a wide range of terms as applied to the behaviour of electric circuits, including potential difference.

3 This question was entirely free response. The most common answer in part (a) was a calculated value of 90 000 J (9 x 1000 x 10) which was incorrect. Only a small minority of candidates converted the time from hours into seconds to give the correct answer (9 x 10 x 1000 x 60 x 60 = 324 000 000J). Weaker candidates often managed to arrive at a value of 90 000 J, but working was rarely shown. A small minority of candidates carried out the calculation using data for the wrong light bulb. Part (b) differentiated well, with more able candidates producing well prepared and concise answers. The weakest candidates struggled here with a significant proportion leaving the question unanswered. Common incorrect answers were kJ or kW in place of kWh.

4 Most candidates could identify the weight and driving forces correctly in part (a). The reaction force from the ground was often identified as a 'repulsive force' or 'counter force', particularly by weaker candidates. Part (b) was extremely poorly answered. Few candidates could identify the partner of force C as the pull of the car on the Earth. The most common answer from even the more able candidates was that the partner force was the push of the ground on the car. This is clearly a topic which centres would be well advised to address in preparation for future examination sessions. The calculation in part (c) was well answered by all but the weakest candidates.

5 Overall, this question differentiated well. The time calculation in part (a) was very well answered by all. More able candidates had little trouble identifying the correct descriptions for average and instantaneous speed in part (b). Weaker candidates could not correctly interpret the graphs in part (c), with the most common wrong choice being graph 'C'.

6 This question on waves produced a good spread of marks across the ability range. Many candidates got caught out with part (a) of this question by only identifying one wavelength and/or one amplitude despite the instructions saying that "each row can have more than on tick". Many weaker candidates felt that 'F' or 'D' represented the frequency of the wave. Very few candidates seemed to know that wave speed is usually independent of frequency and amplitude. Only more able candidates scored well on the calculation in part (c).

7 All of part (a) needed to be correctly completed for the single mark available. It was common to see all but the final link describing an analogue signal to be correct. Part (b) proved difficult for most, although good candidates picked on the idea of removing noise more readily from the digital signal. Most candidates scored one out of two marks on part (c), with the answer 'sound waves reduce in intensity as they travel' proving a popular distractor.

8 Part (a) differentiated well, with weaker candidates incorrectly selecting 'they are transverse waves' as the reason for using radio waves to transmit TV signals. Only the most able candidates could successfully answer part (b), with many of them producing very clearly presented descriptions of constructive and destructive interference. Weaker candidates failed to understand what was being described in the question.

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

General Comments:

The marks earned by candidates for this paper suggested that very few of them would have benefited from being entered for the Higher Tier paper. It was good to find that the overwhelming majority of candidates felt able to have a go all of the questions, although very weak candidates tended to leave blank spaces where they were required to write extended prose answers.

Centres appear to have done a good job in using the Advance Notice article to prepare their candidates for this paper. Candidates were familiar with its contents and readily copied out relevant sections in their answers. Sometimes this was the right thing to do, and sometimes it wasn't; candidates often assumed that the article contained all of the answers, whereas some questions required candidates to think for themselves!

The objective questions relating to module P7 were well answered by strong candidates, and weak candidates usually opted for the obvious distractor or simply guessed. The extended prose answers proved to be more difficult, even for strong candidates. This was either because many candidates appeared not to understand the question or were not precise enough in their use of technical terms.

Comments on Individual Questions:

Q1 This question was based on the Advance Notice article. The majority of candidates were able to successfully identify the correct order of waves in the electromagnetic spectrum for part (a)(i). Although most candidates were able to sketch an analogue signal for part (a)(ii), only a minority were able to do the same for a digital signal. Many lost marks by varying the amplitude of the digital signal or having several steps instead of just two. The vast majority of candidates were able to correctly read the speed from the graph for part (b)(i), but less than half were able to earn the mark for part (b)(ii), with too many stating that the braking force pushed the driver forwards. About half of the candidates correctly named friction for part (b)(iii), with gravity being the most popular incorrect answer. Many candidates ignored the question stem of part (c)(i) and wrote about how much safer motor racing had become rather than discussing the motivation of a driver to face its risks. However, in part (c)(ii), most candidates identified the relevant passage in the article and copied it word for word to earn both marks. Candidates who used their own wording often risked losing a mark by swapping "force" for "energy" or "momentum". In part (d)(i) many weak candidates copied the passage from the article about telemetry, earning no marks. Many of those who actually answered the question set on the paper used weight instead of mass, losing a mark. Finally, it was good to find that at least half of the candidates were able to correctly calculate the kinetic energy of the car.

Q2 This question was about stars. The multiple-choice nature of part (a) meant that most candidates picked up a mark, usually for identifying the core. It was common for weak candidates to label the outermost layer as the radiative zone. Many students omitted to answer part (b)(i); too many drew arrows going into the Sun instead of out. Although many candidates confused fisson with fusion in part (b)(ii), most could correctly identify the fuel for the Sun and Red Giants.

Q3 Part (a) was poorly answered by the majority of candidates, usually because they confused luminosity with brightness. Many earned a mark for stating that increasing distance decreased the brightness, but few explicitly stated that increasing luminosity increased brightness. Even strong candidates made the mistake of trying to explain both factors at the same time so that it was impossible to tease out cause and effect from their answer. For part (b), only a small minority of candidates earned all of the marks, with the hardest mark to earn being the effect of electrons moving between energy levels.

Q4 A disappointing number of candidates were unable to convert temperature in degrees centigrade to Kelvin for part (a). In part (b) many candidates appeared to be confusing a protostar with a star, talking about how fusion made it expand. Although the majority of candidates knew that the temperature increased, only a minority knew that this had to be associated with a decrease in volume, probably confusing cause and effect. However, the majority of candidates were able to correctly identify the factors in balance in a stable star for part (c).

Q5 This question was about the appearance of the stars and Moon in the night sky. Most candidates were able to correctly identify why the stars move at night and are in different places at different times of the year for part (a). Part (b) was about the appearance of the Moon. Although the majority of candidates correctly identified the appearance for the first quarter, too many swapped round the full moon and the new moon, so only earned one mark. Only about half of the candidates knew that the Moon moved from east to west across the sky.

Q6 Part (a) was about the units of measurement for interstellar distances. About half of the candidates could correctly identify the megaparsec and parsec for the first two parts, but many fell into the trap of assuming that a light-year had to be about the same as a light-second. Although most candidates correctly identified the parallax angle for part (b)(i), very many opted for the full angle subtended by the diameter of the Earth's orbit. Only a minority of candidates could select the correct graph for part (b)(ii), with most candidates appearing to guess. Very few candidates earned the mark for Cepheid variable and nebula in part (c), although most knew about galaxies and stars. Similarly, very few candidates could identify Chile and Australia as locations of major observatories for part (d)(i). Many candidates ignored the information provided in the stem of part (d)(ii) and explained how to assemble and use a refracting or reflecting telescope, suggesting that they were unaware of how modern astronomy is carried out remotely through the extensive use of computers.

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

General Comments:

The candidates covered quite a wide range of abilities, with the increase in candidates at the lower end of the ability range noted last year continuing. There was a good spread of marks. The majority of candidates made a good attempt at the paper, with nearly all candidates attempting all questions. There was no evidence of candidates running out of time. Very little evidence was seen of candidates 'killing time' in the exam by scribbling or 'doodling' on the paper, so it appeared that they were kept occupied for a large part of the time.

There was clear evidence that candidates were responding to longer prose style questions better this year. With most filling the available space with writing. Unfortunately this was too often vague and consisted of little more than rephrasing the question, rather than demonstrating their own knowledge and understanding. The quality of writing was often poor; deciphering their answers was often difficult.

Many candidates lost marks through not reading through their script at the end of the examination. Omitted words often led to unclear and/or ambiguous explanations.

Comments on Individual Questions:

Question 1

(a)(i) Most candidates successfully described how the momentum could be found. Of those not gaining full marks, the majority failed to indicate a need for acquiring data eg 'they should get the mass and multiply by velocity' (losing the acquire velocity mark). A small number used 'weight' instead of 'mass' and some others simply listed from the support material on telemetry ie temperature, pressure of tyres, etc.

(a)(ii) This was generally calculated correctly. The most common incorrect response was '50400' were candidates did not square the velocity.

(b)(i) The vast majority gaining a mark did so for mentioning ALARA but very few went on to successfully build on this. Many got the idea of reducing risk but not to a minimum. Many described how the HANS device worked, which was not asked for. Very few mentioned the fact that there will always be some risk involved, and very few mentioned the compulsory usage.

(b)(ii) The majority of candidates knew that crumple zones increase the time taken for the car to come to a stop and many went on to state that this reduces the force but didn't use the formula to justify this second statement. This was why the majority scored only 1 mark. Very few of those going on to correctly use the formula as part of the argument went on to state that the change in momentum is the same. Many responses referred to the absorption of energy by the crumple zone but no responses were seen which developed the energy arguments beyond this single observation.

(c)(i) Many candidates got the order of the spectrum correct. Some had 4 out of 5 (in correct order) but failed to enter the last piece. Common errors were microwaves and radio waves in the wrong order or ultraviolet and infrared reversed. Weaker candidates included alpha, beta and sound.

(c)(ii) The most common correct responses were 'different wavelength' and 'both non-ionising'
Most common incorrect responses involved uses of the waves rather than properties. A significant number had microwaves with longer wavelength or lower frequency. Weaker candidates said that microwaves were longer or bigger.

(d) The marks were usually gained by the diagrams. A few had analogue and digital mixed up, not labelled or showed more than two values for digital, possibly due to carelessness. Virtually all written responses talked about interference and noise. Although many of the written responses referred to digital being 1s and 0s, very few were able to describe analogue signals without a diagram.

Question 2

(a)(i), (ii) and (iii) Very few candidates correctly answered all three. There was no pattern apparent in the incorrect answers. However many candidates appeared averse to but down 'parsec' in answer to two successive questions.

(b)(i) and (ii) Most candidates correctly identified the parallax angle and the inverse relationship graph, by far the most common error in both cases was option D.

(c) 'Stars' was commonly correct, although 'solar system' and 'planets' were often incorrectly stated instead. Virtually all had 'galaxy' in the correct place. Nebula and Cepheid were least commonly correct and often had interesting spellings.

(d)(i) Candidates were often not confident answering this question with many answers exhibiting crossings out. It was not well answered, most ticked 'Chile' but often had UK as well.

(d)(ii) Almost all got 'computers' and 'controlled' with an even spread of alternative marking points met. Some good answers referred to telescopes that did not collect light in visible wavelengths. Very few responses referred to the processing and enhancement of images. Those not getting many marks gave an answer about reflecting telescopes or lens and improvements made in optics.

Question 3

(a) Some excellent answers were seen here. However most answers were at best muddled and often used current knowledge of the structure of the atom and assumed that this was the same as Rutherford's knowledge. The most common correct responses were 'atom mostly space' and 'nucleus is positive' although many were too vague; 'atom has space' etc. A small but significant number referred to gaps between atoms or the atom being filled with air! A significant number lost marks for not linking feature and evidence together. Too many candidates talked about strength of atom or alpha particle; 'this shows that the atom is weak' etc.

(b) This question was badly answered. The most common error here was to restate the reverse of the question eg 'because if it (the strong force) wasn't there, it (the nucleus) would fall apart' The number of candidates that talked about neutrons repelling protons, or neutrons having positive charge, or strong force needed to keep protons and electrons together was surprising. Those gaining marks generally got them for 'protons repel each other'. Very few candidates talked about the strong force 'overcoming/balancing' etc.

Question 4

(a) Most candidates got 'photosphere' correct, Some candidates answered convection zone (rather than convective zone).Few candidates gave radiative zone; a surprisingly common error was 'radioactive zone'. Weaker candidates had the misconception that the diagram represented the Earth. Hence; crust, mantle, core.

(b)(i) Hydrogen was most commonly given as the correct response. Helium was less common. 'Fusion' was virtually always given, although a common error was to misspell fusion as 'fussion'.

(b)(ii) 'Radiation' or 'light' were common correct responses. "Heat" was a common response – it was given no credit as was 'convection'.

Question 5

(a) A challenging question, some responses were very "woolly" – very unsure, had some idea but could not clearly express the concept. Most candidates got the idea of line spectra and then linked this to identifying elements but very few referred clearly to the idea of unique lines for elements. A small number of candidates were able to describe the movement of electrons. A common misconception was that the chemicals themselves rather than photons of their light produced the lines in the (absorption) spectrum.

(b) Marks for linking temperature to colour and blue being hottest were most common awarded. Some candidates slipped up on terminology, eg luminosity and intrinsic brightness. Very few candidates linked wavelength/frequency to colour. There were few irrelevant answers, but many lacked detail.

Question 6

(a) Answers ranged from 3000 to -370, the most common error was -276. A few candidates correctly answered 270 but forgot the negative sign.

(b)(i) Most candidates got the idea of increased pressure and particles colliding more frequently. Those answers not gaining marks were often too vague, eg 'gain energy' not 'gained kinetic energy' or referred to 'faster collisions'

(b)(ii) Quite a lot of candidates mentioned gravity without any idea of balance or referred to fusion and creation of new matter to compensate for lost energy and matter. A common error here was to link the unchanging volume to other unchanging factors, eg pressure stays the same so the volume does not change etc.

A339/340 Principal Moderator's Report – Skills Assessment

GCSE Science A, Additional Science A, Biology A, Chemistry A and Physics A

General Comments:

There has been a continued improvement in a number of areas in the interpretation and application of the assessment criteria. However, certain aspects continue to be demanding and challenging for candidates and the spread of marks over the cohort is sufficient to allow secure differentiation between grades.

The Skills Assessment component of each of the above specifications is weighted at 33% and it was still evident that some centres were not developing the underlying skills, knowledge and understanding of Ideas about Science in their candidates before an assessment took place.

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

- Section 1: Administrative issues
  General comments
  Annotation
  Internal moderation
  Type and context of work of assessed work
  Nature of practical work
  Candidate helpsheets and teacher review of coursework
  Plagiarism
- Section 2: Assessment and marking framework
  Calculating the Strand mark
  Marking strands I and P in Data Analysis and Investigations
  OCR cover sheet for candidates' work
- Section 3: Data Analysis
- Section 4: Case Studies
- Section 5: Investigations
- Section 6: Final comment

Section 1: Administrative issues

General comments

Few Centres this year included details of how each of the tasks used for assessment had been introduced and presented to candidates. Those Centres that did not provide this information meant that on occasions moderators could not support the marks that were awarded by the Centre. This did lead to mark adjustments in some cases.

Annotation

Most candidates' work was annotated with the use of the assessment criteria codes eg I(b)6, at the appropriate point in candidates' work showing where the marks were awarded. However, in far too many cases the annotation was a very generous interpretation of the criteria and sometimes completely incorrect.

Internal moderation

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 inconsistent between different teachers the Centre may be required to provide further samples of work and possibly re-

mark the work of all their candidates. There were still too many incidences of unsatisfactory internal moderation reported by the moderating team this year.

Type and context of assessed work

Following guidance from the Joint Council for Qualifications (JCQ), coursework has to match both type (eg Data Analysis and Case Study or Investigation) and context (ie Biology, Chemistry or Physics) as appropriate for the specification concerned. Only a few Centres did not meet these requirements this year. As a reminder, 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.

Nature of Practical work allowed for assessment

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

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.

Candidate helpsheets and teacher review of coursework

There was evidence that some coursework from a small 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 and Centres are required to consult and abide by this http://www.jcq.org.uk/attachments/published/1260/14.%20Coursework%20ICC%201011.pdf

Teachers may review coursework before it is handed in for final assessment provided that advice remains at the general level. Having reviewed the candidate's coursework it is not acceptable for teachers to give, either to individual candidates or to groups, detailed advice as to how the work may be improved. 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).

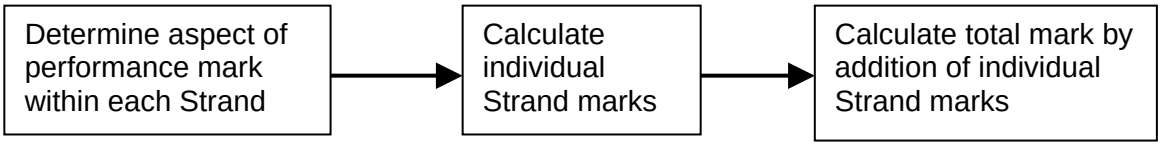
Candidate helpsheets of the generic type which are applicable to any task are allowed and whilst helpful for lower achieving candidates can restrict the opportunities for those higher achieving candidates. There was evidence that some Centres were providing helpsheets which rather than giving broad headings to guide their candidates were providing a very detailed breakdown of points and leading questions involving particular words or phrases in the mark descriptions which went beyond the spirit of teacher support and guidance. In these cases Centres sometimes awarded marks when candidates repeated the same words and phrases without demonstrating any understanding. Marks had to be adjusted in these situations.

Plagiarism

Quoting from the same JCQ document as previously mentioned, "Candidates must not copy published material and claim it as their own work. If candidates use the same wording as a published source, they must place quotation marks around the passage and state where it came from. "**Candidates must give detailed references even where they paraphrase the original material"**. There was evidence that in some cases, particularly in the Case Study, candidates were not following these procedures. "These actions constitute malpractice, for which a penalty (eg disqualification from the examination) will be applied".

Section 2: Assessment and marking framework

A significant number of Centres are still not following the correct procedure for calculating the Strand mark from the appropriate aspect of performance marks and are being required to re-mark all their candidates' work.



Determination of the Aspect of performance marks
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. There was a tendency for some Centres to award marks on the basis of candidates matching one high level aspect of performance description within each Strand without ensuring that the underpinning descriptions had been matched.

Calculation of the Strand mark
(a) Three aspects of performance per Strand
Where there are three aspects per Strand the following examples illustrate how to convert aspects of performance marks into Strand marks. **Add the three aspect marks together, divide by three and round the answer to the nearest whole number.**

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

(b) Two aspects of performance per Strand (B and C of the Case Study)
From experience it is best to consider both strands B and C together when arriving at the final strand mark for each.

If **both** B and C average to (N + ½), then one should be rounded up and the other rounded down.
eg B(a)4(b)5 and C(a)5(b)6 then Strand B = 4 and C = 6 giving a total of 10 marks.

*If **either** B or C averages to a whole number (N) and the other to (N + ½), the ½ **could be rounded up or down on the basis of professional judgement***
eg B(a)4(b)6 Strand B = 5; C(a)5(b)6 Strand C = 5.5 which could be recorded as either 5 or 6 marks depending on judgement giving a total of 10 or 11 marks for these two strands taken together

Marking Strand I aspect (a)
This aspect 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 recorded on the candidate coversheet but not both marks**.

Marking Strand P aspect (b)
The first row is concerned with recording quantitative data, the second row deals with the use of conventions and rules for showing units or for labelling in tables and the third row deals with the recording of qualitative data. Most investigations involve the collection and recording of quantitative information and in these cases, the aspect mark will be determined by averaging the mark in the first and second rows only, ignoring the third row completely. For those rare investigations which include qualitative evidence only, 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 the 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 (iii) n/a	5	
P(c)	7	7	

Candidate coversheet
All marks must be recorded on the OCR coversheet 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 or fully complete a coversheet at all.

Section 3: Data Analysis

General comments

Centres are reminded that candidates must have personal firsthand experience of collecting data by performing a practical experiment. The data that they collect can be supplemented by further data from, for example, incorporating a class set of results. It is helpful if the data that is collected by the candidate themselves is clearly identified. **Work which is based purely on teacher demonstrations, computer simulations, given sets of results etc is not acceptable.**

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 the inclusion of a data table in their report. It would also be helpful if candidates or teachers included the method that they used to collect data so that marks for E(b) could be more securely supported.

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 **provided the subject context is appropriate for that specification**. If this is the case, Centres are required to indicate this on the appropriate coversheet and include appropriate photocopies of the work in both samples.

Data Analysis tasks.

There was a continuing variety of data tasks seen by moderators such as

Resistance of a wire
Osmosis
Respiration of yeast
Parachute drops
Crater impact
Rates of reaction
Effect of water depth on a 'tsunami'
Stretching elastic bands, springs
Pendulum
Cooling curves
Clotting of milk
Bouncing of squash balls
Pulse rate and exercise

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.

Those candidates who understood and used the terminology and concepts related to Ideas about Science, such as 'correlation and cause', 'outliers', 'reliability', 'accuracy', 'best estimate', 'real difference' found it easier to match the performance descriptions of the criteria and gain higher marks.

The majority of candidates at nearly all levels repeat their measurements when performing practical tasks which is most encouraging. However, many candidates do not necessarily appreciate the reasoning behind such practice and often those results which were clearly outliers were included in calculating averages and incorporated into conclusions. It was very rare to see that a candidate had performed further repeats to replace the outlier to ensure that the data is reliable and of the best quality. Plotting rough graphs as the data is collected may help candidates to identify outliers as they are collected so that marks for E(b) can be awarded and that their conclusion maybe more clearly and confidently established gaining credit in both I(b) and E(c).

Strand I: Interpreting data

I(a): Most candidates analysed their data using bar charts or graphs to illustrate and process the data that they had collected rather than a numerical analysis. Whilst many candidates now plot all their data and often include range bars the quality of graph drawing often shows lack of care in plotting the points accurately, using suitable scales and labelling axes correctly and drawing a line of best fit accurately and carefully. Many graphs were given high marks when one or more of these aspects were not of the accepted quality and more scrutiny is needed by Centres.

As a reminder the following guidelines provide more guidance about what is required but it is not intended to be comprehensive and to cover all eventualities.

- I(a) 4 – simple charts, bar charts
- I(a) 5 – a dot-to-dot graph or axes not labelled or incorrectly plotted point(s) or poor quality best fit line
- I(a) 6 – graph with correctly plotted points, correctly labelled and scaled axes and correctly drawn best fit line.
- I(a) 7/8 – **in addition to the requirements for 6 marks** candidates must show evidence of awareness of uncertainty in data eg range bars, scatter graphs.

If candidates use a numerical approach to analyse their data it is expected that candidates will be able to correctly calculate averages from repeat readings for 4 marks, do more complex calculations such as calculate percentage differences for 6 marks and for 8 marks calculate gradients from graphs or use simple statistical methods. Those candidates who have drawn a poor line of best fit on their graph but succeeded in calculating a gradient correctly may be awarded up to 5 or possibly 6 marks.

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 ie they must be correctly sized and scaled with suitable grid shown and with the appropriately sized plotting points. However, it is generally better for candidates to hand draw their own best fit line.

Centres are reminded that only one single mark must be used for I(a), either that for graphical or that for numerical work but 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.

I(b): The match to I(b)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' which only merits 4 marks. For 6 marks candidates should derive a more quantitative statement using their data to show what happens when for example concentration or lengths are doubled and noting the direct proportionality between variables.

Very few candidates matched the requirements for I(b)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 can the best fit line 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.

I(c): Many candidates introduced their experiment by describing any related background theory even if it wasn't all relevant to the particular experiment they were doing. Candidates are better served if they link their conclusion directly with the appropriate scientific explanation that applies. Most candidates could secure a match to I(c) 4 by explaining their conclusion using scientific ideas. However, there was still some very generous marking when matching to I(c)6 and I(c)8 in terms of the detail and quality of the scientific knowledge and understanding shown. It is not just a few key words that must be considered but the actual meaning and correctness of a candidate's explanation of their conclusion that must be judged when arriving at the final mark.

Strand E: Evaluation

The majority of candidates achieved between 3 or 5 marks for this strand, showing improvement in E(a) and (b) but less so in E(c). 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',

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

E(a): The E(a)4 performance description is the 'gatekeeper' to access the higher marks. It requires candidates to identify any limitations or problems in their procedures that they encountered during their practical work. However, in many cases comments were limited to human error rather than systemic experimental ones. Candidates should then consider the limitations that they have identified and suggest suitable improvements to match E(a)6 and 8. A number of the suggestions made were not always of sufficient quality to be creditworthy eg 'do it with a computer' or 'repeat my measurements more times' without any justification or explanation.

E(b): The majority of candidates generally identified a data point as an outlier either in the table of results or on the graph E(b)4 but only the better candidates provided an explanation of why a particular result had been chosen. The majority of candidates now regularly draw lines of best fit and range bars on their graphs but many of them do not make the connection when discussing reliability and accuracy of their data. A limited number of candidates used more objective ways of assessing reliability and accuracy using simple statistics such as variations of the Q test procedure. 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.

E(c): Marks were often very generously awarded and this aspect still continues to be poorly addressed. This aspect involves bringing together the discussion about the reliability of the data collected and the procedure to establish a level of confidence in the conclusion. Better candidates referred back to their conclusion in I(b) expressed in either qualitative or quantitative terms and used their discussion in E(a) and E(b) to link them all together in establishing the appropriate level of confidence. Those candidates who had expressed a conclusion in quantitative terms had more opportunity to provide a more detailed analysis and evaluation to access the higher marks.

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 I(b) about the limitations in the conclusion. In addition for 8 marks, weaknesses in the data should be identified eg a limited range or not enough readings at certain values, or degree of scatter too large or variable, and suggest in detail what more 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 otherwise their conclusion. Some candidates recognised that their conclusion can only apply to the range of values that were studied because outside this range, for example, the rate is bound to slow down as one of the chemicals gets used up, the rubber band will eventually break, more exercise cannot always mean that pulse rate continues to increase.

Section 4: Case Studies

General comments

The Case Study is a critical analysis of a controversial scientific issue in which candidates use their knowledge and understanding of Ideas about Science. Those candidates who 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' found it much easier to match the performance descriptions of the criteria and gain higher marks.

Most candidates title their Case Study in terms of a question and collect appropriate evidence to illustrate both sides of a case. However, the analysis and evaluation of such evidence to derive a personal conclusion is still proving very demanding for the majority.

Many Centres provided a short list of appropriate Case Study titles for their candidates to choose from thus allowing them to select one which is the most appealing on an individual basis. It is important that titles for case studies do provide the necessary focus for candidates and don't just illicit a yes/no response but encourage a more thoughtful response with possible suggestions of future action. Those Centres who allow a more open selection of topic must closely monitor their candidates' choice to ensure that it is appropriate and firmly embedded in a scientific context with opportunities to gather evidence both 'for and against'. Surprisingly many candidates did not make full use of the relevant information and material in their student textbook often preferring to use only material from the internet.

A number of familiar examples were seen again this year but some such as 'Should smoking be banned in public places?' were seen much less frequently as their relevance diminishes.
Some examples of Case Study titles included this year –

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 developing alternative energy resources?
Is the MMR jab safe?
Is global warming natural or man-made?
Is sunbathing safe?
Does pollution from traffic cause asthma?
What killed the dinosaurs?

The approach adopted by candidates who presented case studies on the following issues seemed to provide limited access to the higher levels of the assessment criteria.

Is organic food best?
Aspects of diet eg "Is obesity inherited?"
Should animal testing be allowed?

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 candidates who did not acknowledge their sources either when they copied and pasted information or when paraphrasing original material are guilty of malpractice and can incur a significant penalty. Those reports which were presented simply as PowerPoint printouts almost always lacked sufficient detail to access the higher marks.

Strand A: Quality of selection and use of information.
There was continuing evidence of improvement in the marks awarded for this strand compared to last year.

A(a): Candidates must select and use sources of information to provide evidence to support both sides of the argument in 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. It was this latter aspect that only the very best candidates were able to show.

If no sources are credited then a maximum of 1 mark will be allowed by moderators. Higher marks require that sources represent a variety of different views or opinions and it is quality rather than quantity which separates the award of 2 or 3 marks. Many candidates who were awarded 4 marks incorrectly often made token reference to reliability but did not explain why they thought their sources were reliable. Those candidates who used the language and ideas from IaS 4 eg ideas about peer review, the nature of the source or the status of the author were much more likely to secure the top mark.

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 eg website homepages would be awarded 2 marks. If only one or two incomplete references are given then one mark should be awarded and if no references are given then zero marks. For 3 marks candidates included complete references to the exact url address of the webpage and when referencing books, the title, author and page references would be required. For 4 marks it is expected that candidates include some information about the nature, purpose or sponsorship of the site. It is also to be encouraged that candidates record the date when they accessed the information from an internet site.

A(c): Candidates were still not very good at clearly showing where sections of text were directly quoted. Use of quotation marks, use of a different font or colour highlighting, were some of the methods used by the better candidates. The better candidates also included references within the text to show the source of particular information or opinions quoting the specific author and then using, for example, numerical superscripts linking to detailed references in the bibliography. Credit is given, not so much for the quotation itself but for the comment made by the candidate 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.

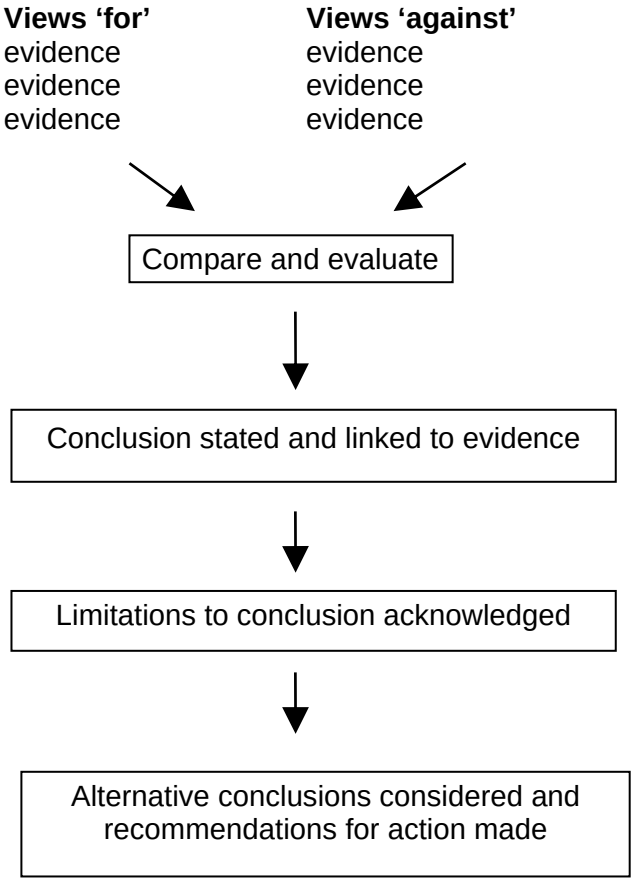
The majority of candidates described the relevant background science in the introduction to their case studies. However, it was only the most able who could integrate their scientific knowledge and understanding with the claims and opinions reported in their studies or extend the scientific knowledge 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 and/or evidence. It is useful before marking candidates' work to look at the appropriate pages in the C21 textbook about Science Explanations and the Ideas about Science and also the published OCR exemplars to know in advance what material should be included. 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 in B(a) requires all of the relevant science from the student book. The 7th or 8th mark will come either for applying and integrating this correctly to the case, or for finding and explaining some more additional science related to their Case Study.

Aspect B(b) focuses on candidates' ability to identify, report and evaluate the scientific evidence that any claims and opinions are based on. Most candidates were able to recognise and extract relevant scientific content from their sources and were awarded 4 marks. Candidates who were awarded 6 marks referred to the evidence base of the various claims and opinions providing generally quantitative information from research studies. Candidates obtaining 7 or 8 marks look more critically at the quality of the evidence. They used terms like 'reliability' and 'accuracy' when considering data, they looked at the strategies involved in collecting the data and they also compared the reliability of data between sources. For many 'life-science' studies, for example the popular MMR study, the evidence is largely drawn from epidemiological studies and good candidates should be looking for evidence of factors such as sample size, or how subjects were selected to evaluate the importance of the evidence. Even strong candidates tended to rely too much on summaries of conclusions rather than describing the evidence base.

Strand C: quality of conclusions

Strand B gives credit for the level and detail of the relevant science described and for reporting the associated evidence underpinning the various claims and opinions. Strand C awards credit for candidates who provide individual input comparing and evaluating the evidence and, using their own judgement, 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.

Those Centres who guided their candidates to organise their reports with the following headings in mind and to encourage them to develop their critical skills invariably achieved higher marks.



An approach adopted by a number of candidates this year was to copy and paste significant amounts of information from articles on both sides of the case. In most cases, the only comment added by the candidate was a short paragraph headed 'evaluation', but which was usually just a summary of the content. This warranted lower marks than centres had awarded.

Most candidates could sort the information that they had gathered into views 'for and against' and were awarded 4 marks in C(a). Better candidates started to compare similar aspects in both their 'for and against' list and were awarded 6 marks. The best candidates built on this foundation and provided detailed comparisons and evaluation demonstrating considerable analytical and evaluative skills.

When making their conclusions, many candidates referred to the evidence that they had gathered and were awarded 4 marks in C(b) whereas those who omitted any reference were limited to 2 marks. Better candidates described their own viewpoint or position in relation to the original question 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. Many candidates 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 better 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): Many candidates only included images which were decorative rather than informative and therefore failed to clarify difficult scientific ideas and improve effective communication. 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 one 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 eg 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.

Section 5: Investigations

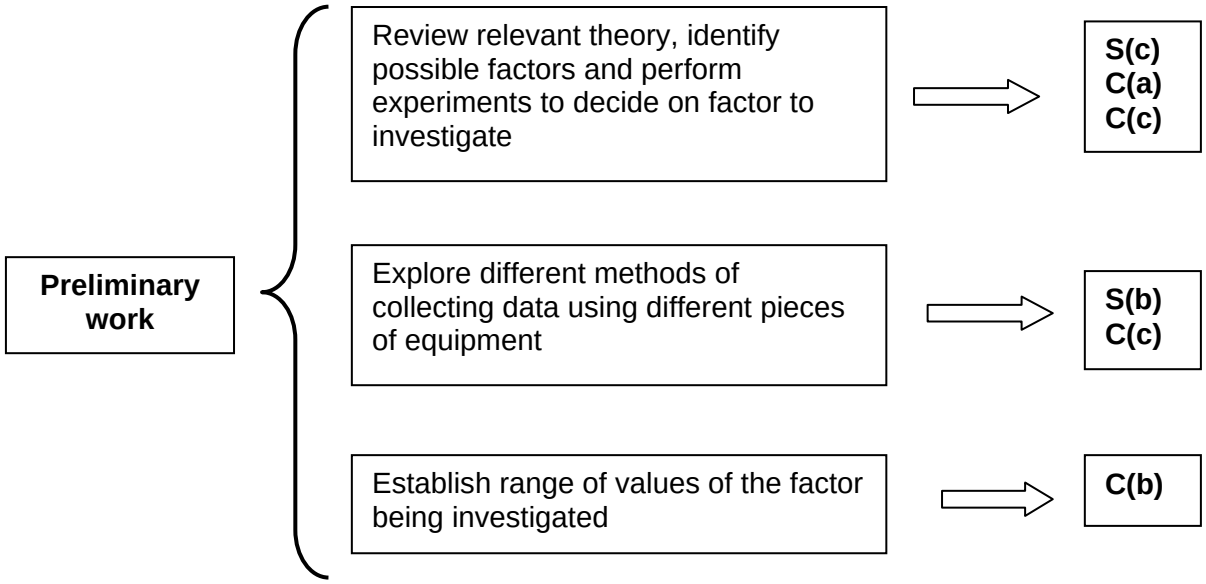
Rates of reaction, resistance of a wire and osmosis were still the most common investigations seen from Centres. However, there was evidence that other topics were being developed by more Centres who had gained confidence from previous years, for example, stretching of plastics and other materials, exercise and fitness routines, efficiency of wind turbines, objects rolling down slopes or ski jumps, electrolysis, investigations involving titration and electromagnets.

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. There were a number of examples where credit had been incorrectly given for the inclusion of a key word or phrase but on reading the context in which it was written it was clear that the candidate had not understood or appreciated the correct meaning.

Strand S: Strategy

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. Many Centres were clearly encouraging a more open ended exploratory approach and it is essential for

moderation if centres provide details of how the tasks were presented to candidates (eg copies of briefing sheets etc.)



Although there was evidence of candidates doing preliminary work, it was often the case that candidates from the same centre used the same quantities of materials, the same apparatus and technique and identical ranges and values of the same variables. This clearly indicated that limited individual decision making had occurred necessitating a downward adjustment to the marks for S(c) in a number of Centres. Where candidates had been given the opportunity to show autonomy they performed well across many of the Strands.

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 hadn't really understood why they were doing it.

Candidates should consider what factors or conditions might affect the results they will get. This will usually involve a brief review of the relevant scientific theory supported by one or two simple practical experiments to compare the magnitude of the different effects and ease of experimentation. This will allow candidates to decide which factor it would be best to study and also provide evidence which can contribute towards credit for C(a) and C(c).

Many candidates provided a list of appropriate apparatus for their investigations but had not linked it to their preliminary work and not indicated why they had been selected in preference to alternative equipment. 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). Candidates need to explore different methods and choose between different pieces of apparatus and adapt as appropriate to find the best way to collect good quality data C(c). Some candidates provided very simplistic justifications and Centres are reminded that it is **quality** of response in this context that is being rewarded. Many Centres provided a fixed, limited set of apparatus for candidates to use 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 the demand and challenge involved in the approach adopted by the candidate and includes such indicators as the

familiarity of the activity and method, the skills involved in making observations or measurements, single or multi-step procedures, 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. 'Resistance of a wire' investigations were frequently over marked in this aspect.

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 for C(a) and only by inspection of the results table could any evidence be found. Better candidates described in detail how the factors had been controlled and, even more importantly in some cases, 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 done or monitored. Often room temperature was mentioned as being the 'variable controlled' in rates of reaction or resistance investigations which was not the key 'temperature' variable involved.

Preliminary work is essential because if done properly it can allow access to marks of 7 or 8 in aspects (b) and (c). There was continuing evidence this year that candidates were doing preliminary work to establish the range of values of the appropriate variable to be used C(b). However, although some candidates presented their results in a table they 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 when calculating average values. It was very rare to see that a candidate had performed further repeats to replace the outlier to ensure that the data was reliable and of the best quality. Plotting rough graphs as the data is collected may help candidates to identify outliers as they are collected which can contribute towards credit for E(b), towards defining the trend in the results more clearly, I(b), and for an improved level of confidence in the conclusion E(c).

From inspection of results tables it was pleasing to see that candidates were taking more care and data was generally of good quality. However, there was little evidence of candidates performing preliminary work which involved making decisions about adapting the type of apparatus or method 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. For more details see the comments in the Data Analysis section.

Many candidates still introduced their investigations with a significant amount of background theory which was not always relevant but more importantly was not used to explain the particular conclusion that the candidate had derived from the investigation. The C21 model for investigations aims to give credit for 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 I(c) and detailed explanations using relevant scientific theory are best left until they are needed in Strand I.

Some candidates provided further comment about the confidence level E(c) in their conclusions in terms of how close the agreement was to their predictions using scientific theory. Some candidates whilst investigating the effect of length on the resistance of a wire plotted appropriate data and calculated resistivity and compared with data book values.

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.

Section 6: Final comment
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 thorough and professional job carried out by the majority of centres. However, there appeared to be an increase in **errors in calculating the Strand marks for candidates** which resulted in considerable extra work for both moderators and centres (please consult the administrative issues section in this report).

There is further guidance about the interpretation and application of the assessment criteria and also illustrative coursework exemplars on the website www.ocr.org.uk. It is highly advisable that staff have time during the year for internal standardisation meetings to share and develop expertise in the Science Department.

The structure of case studies, data tasks and investigations has been modified in the new specifications for teaching from September this year, in the light of the new regulations for controlled assessment. Training for the new model is on-going and details are available in the OCR Training Handbook.

2011 Grade thresholds for Data Analysis and Case Study combined and Investigations for the different specifications.

	Grade threshold								
Component	**Max. mark**	**A***	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Data Analysis and Case Study	16 + 24 = 40								
Investigations	40								

Previous reports from 2008, 2009 and 2010 will still be available online at www.ocr.org.uk to provide further detailed guidance.

The grade thresholds have been decided on the basis of the coursework that was presented for award in June 2010. The threshold marks will not necessarily be the same in subsequent awards.

Some adjustments may be expected to maintain consistent standards across all the OCR Science specifications.

Geoff Mines (Principal Moderator) on behalf of the Moderating Team 13.7.11

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