GCSE

Physics A

Twenty First Century Science Suite

General Certificate of Secondary Education **J245**

OCR Report to Centres June 2015

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

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

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

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OCR REPORT TO CENTRES

A181/01 – Physics A Modules P1, P2, P3 (Foundation Tier)

General Comments:

Candidates were able to show that they had engaged with the course and used their knowledge effectively to answer the questions. Most candidates seemed to have enough time to attempt to answer all the questions they could do. They performed well on short answer and tick box questions, but many were unable to apply their knowledge to new situations.

Candidates were able to do the basic mathematics calculations required. From the calculations that were written out it was clear that some did not have a calculator available to them. In the six-mark extended-writing questions, some candidates only answered part of the question and this restricted the marks they were able to achieve on those questions.

Comments on Individual Questions:

Question 1
This question was well answered. The most common mistake was to say that the Sun produced energy by fusing carbon. Some candidates thought that the Sun was a planet.

Question 2
2(a) A common error was to tick the factually correct choice ‘The Earth’s crust is made of tectonic plates’.

2(b) Similarly, ‘Different continents have exactly the same rocks’ was a common incorrect answer for this question.

3(a)(i) Most candidates correctly read the speed of the tsunami from the table.

3(a)(ii) Candidates who were able to calculate the speed generally forgot to divide by 1000 to convert their answer to kilometres.

3(b) Candidates did not know the meaning of directly proportional. Many were able to state that as one quantity increased the other also increased and many others assumed that it meant the two values were the same. Parts b) and c) were on both the higher and foundation paper, and were some of the more difficult questions on the foundation paper.

3(c) Candidates often gave their answers in terms of ‘bigger waves’ and it was not possible to credit this as they had not explained whether they were referring to the wavelength or to the amplitude. Those that did use the correct terms generally scored marks. There was a misconception that the frequency would change, presumably because the wavelength had changed. Candidates did not realise the significance of the earlier part of the question – i.e. that the speed had also changed. Other candidates wrote that, ‘The wave speeds up as it approaches land.’ Several candidates tried to answer in terms of P and S waves.

Question 4
It was disappointing not to see more diagrams of the solar systems with the orbits shown. A large number of candidates sensibly used the data they were given to draw 5, or sometimes more, planets and a larger central star. Some did not write anything about the formation – most of the marks awarded were given for the drawing. A few candidates did describe the formation of stars and the formation of planets. Applying what they knew to an unfamiliar situation caused problems for many. Some candidates did not attempt the question and others wrote that they

had not learned about Tau-Ceti. There were a number of answers indicating that Tau-Ceti was formed, like the Sun, by the Big Bang.

Question 5
5(a) The digital signal was more often correct here. Some candidates did not use the information given but wrote about advantages and disadvantages as differences.

5(b) Generally candidates who used 0s and 1s got this correct but it was common to see the numbers 0,1,2,3,4,5 written in the boxes.

5(c) Many candidates successfully gave an answer about clarity, noise, or, more rarely, signal quality. Fewer gave a creditworthy second advantage. There were vague answers about better or stronger signals.

Question 6
6(a)(i) This was very well answered, showing candidates had practiced graph work and data analysis. However, some candidates must be more careful when copying information; sometimes 200 was given instead of 2000.

6(b)(i) and **(ii)** These were well answered. Where candidates scored only one correct answer there was no one name that was commonly incorrect.

Question 7
Most candidates were able to state that people would worry about the harm to their bodies. Better answers specified the head or brain. A few seemed more worried about the damage to the phone. Some candidates thought the egg was cooking because the phones were hot, so this would cause damage to hands and pockets. It was good to see able candidates giving sensible reasons for doubting the journalists – often in terms of lack of evidence and scientific testing. A few candidates wrote statements like ‘Just imagine what it would do to a person’ which sadly, did not answer the question.

Question 8
8(a)(i) Most candidates read the maximum power correctly, a few gave 1.8kW

8(a)(ii) Many candidates did not realise they needed to use the graph to find the power. They thought that 7.5 m/s must feature in the calculation. It was common to see 24 x 7.5 = 180.

8(b) Many candidates said something about generating more power, or about needing more power for heating. There were a number who seemed not to understand the term wind farm. They thought that wind farms grew crops, or that the farmer could use the electricity to keep the animals warm. Some candidates thought that the electricity made in the winter could be stored to use in the summer.

8(c) This was answered well. Candidates must take care to follow instructions; as all the boxes needed completing.

Question 9
9(a) Lots of correct answers. Those candidates who slipped up in calculating the energy often still scored for totalling the values correctly.

9(b) Most candidates correctly chose 90p here.

9(c) This was quite varied with wrong answers spread among the possible options, but ‘The oven and kettle are connected to a higher voltage’ was the most common incorrect answer.

Question 10

Candidates often gave the advantage of gas to be that the power stations produce a lot of energy, but this is not generally true when compared with nuclear power stations. Some candidates grouped both stations together to give the advantages and disadvantages of both (presumably when compared to renewable options). Better responses mentioned carbon dioxide and/or global warming. 'Air pollution' was a weaker answer often seen, and some other weak answers simply cited 'pollution'. A lot of candidates thought that nuclear was a renewable option, that nuclear power stations are cheap to build but expensive to run, and gas power stations are safer.

A181/02 – Physics A Modules P1, P2, P3 (Higher Tier)

General Comments:

This is the second examination series in which all physics and science candidates entered their examinations at the end of the course, and the candidates' performance this year was similar to that of last year.

Few candidates seemed to have been short of time, and examiners commented that the majority tackled the questions well in extended-writing but that the mathematical aspects were less well done. Answers were generally clearly and logically presented but there were a number (some high-scoring) which were very difficult to decipher and may well have lost marks from this.

A number of low-scoring candidates were clearly entered for this paper when they would have been much more successful in the foundation tier, and their papers were characterised by many questions being left unattempted.

Examiners frequently reported on two aspects of candidates' performance which need to be brought to attention to centres.

(i) Many candidates find it hard to express themselves clearly in English. This is obviously a feature of the 6-mark questions, but other questions (such as 2b, 2c, 5b and 12a) also require the candidate to communicate his or her ideas to the examiner. There is no need to use elaborate English: simple, short sentences will do very well, and bullet-points are often a good way of organising one's ideas.

(ii) Mathematical skills are an important aspect of GCSE Science/Physics, and will continue to be so in the revised GCSE. Many candidates found the organisation of calculations very difficult, and this is made more noticeable when standard form or the conversion between units, e.g. between kW and MW, is involved. It is clear that the majority of candidates, in question 2(b), believed that 'the speed is directly proportional to the depth' meant 'as the depth does up, so does the speed' which is not enough for credit as the mathematics skills (listed in Appendix C in the specification) include 'understand and use direction proportion and simple ratios.' Examiners did point out, however, that candidates who laid out their working in a methodical, clear way would often rescue marks from an incorrect answer as they had shown that they had covered some necessary stages of the calculation correctly.

Comments on Individual Questions:

Question 1
This extended response 6-mark question was common with the foundation tier paper, and over 50% of the candidates achieved a higher level 2 or a level 3 mark. Diagrams of the planetary system (often labelled as if it were our solar system) were usually good, but the orbits were often not clearly shown and sometimes there were two or more planets following the same orbit. The best candidates did answer the question as written ('...describe how the different parts may have been formed') but there was much confusion with the Big Bang.

Question 2
2(a)(i) Candidates were required to convert the given time into seconds, calculate the distance travelled at 180 m/s in the time they had deduced, and then convert the answer into km. Few managed all three steps with no errors, and the commonest mark awarded was the second one, with 'error-carried forward', i.e. getting the wrong time but then correctly using that value to find a distance, which was often then not converted from m to km.

2(a)(ii) About half the candidates could estimate a depth which required a simple interpolation between two values in the table. Unsuccessful candidates here went for the greatest possible depth, or averaged the six values in the table.

2(b) Very, very few candidates could explain what direct proportion meant or demonstrate that the given data did not display it.

2(c) Candidates who applied the appropriate terminology of wavelength and amplitude to the diagrams usually earned both marks, but weaker responses referred to 'bigger waves' or 'more powerful waves' in a vague way.

Question 3
3(a) Most candidates scored 2/3 marks when answering this question. Some candidates missed the fact that the third observation was not enough to support Wegener.

3(b) This question required both correct boxes for the mark, and the two other facts given were both correct, but irrelevant here: over half the candidates were able to answer this question correctly.

Question 4
4(a) This question was also on the foundation tier, and was completed correctly by most candidates

4(b) Less than one-third showed understanding that all chemical elements with atoms heavier than helium were made in stars.

Question 5
5(a) This question was common with the foundation tier paper, and most candidates scored very highly.

5(b) This part was more demanding than part (a), and many candidates clearly did not read 'State and explain **two other changes** (i.e. other than flooding) that could result from global warming.' There were a number of vague pre-prepared answers about global warming (including the inevitable references to the ozone layer) which did not address the question but gave generalised answers vaguely related to global warming issues, such as how to reduce carbon emissions

Question 6
Roughly half of the candidates referred to noise in mark in (a), with about a quarter of those getting the second mark for stating that digital signals could be stored or processed by computers. The objective part (b) was surprisingly poorly answered, quite possibly because candidates found it hard to put ticks in almost all of the boxes.

Question 7
This extended response 6-mark question was well answered in general: very few candidates failed to give advantages and disadvantages associated with the use of mobile phones. Level 3 responses to this question required demonstration of the fact that microwave radiation was non-ionising, that microwaves were able to heat tissues and (very rarely seen) the fact that the brains and skulls of children are still developing, so may well be more susceptible to damage. Better answers spelled out the fact that there is no agreement that the use of mobile phones is risk-free, but that there is as yet no proof that any risk exists. Weaker answers postulated that the radiation may be radioactive, or cause mutations, or over-heat the brain of the user. A popular postulated risk was the social one of grooming or bullying through email or social networks: these responses were accepted.

Question 8
The strongest candidates typically obtained two of the three marks in this multi-stage calculation, typically making an error in one stage. Weaker candidates tended not even to attempt the question.

Question 9
This was an objective question, so few left it blank, but relatively few candidates got all three parts right. Part **(a)**, requiring the candidates to calculate power and then convert from watts to kilowatts, was the least well done while part **(b)**, which asked candidates to scale up the energy from that for a 1°C rise to an 80°C rise, was done well by most. It was surprising, in part **(c)**, how many candidates expected the kettle to boil in 0.4 seconds, or were happy that it would take over an hour to boil.

Question 10
10(a) This question was well answered.

10(b) Relatively few candidates labelled the boxes to name the parts of the system, instead they described the process. Provided that the candidates description involved a turbine, followed by a generator and then a transformer, even in the same box, credit was given. A large number did not read 'hydroelectric power station' and including a boiler, or a description of its function, in the system.

Question 11
This was the most demanding extended response 6-mark question on the paper, and over half the candidates restricted the marks available to a maximum of 2 by failing to make any reference to the efficiency graph. As the question stem provided a graph, a map and a bar chart, candidates should expect to have to extract information from all three.

The question stem stated that a factor to consider was the distance from the wind farm site to the consumers. Candidates read this in two different ways: that transporting energy over a greater distance involved greater energy losses, or that having a wind farm close to where many people live was unsightly and a source of noise pollution. Both arguments were acceptable. The best answers compared summer and winter performance at the different sites and deduced that a wind farm at Paisley would produce little if any power whereas Kirkwall would be the most productive, often choosing Kinloss as a compromise between efficiency and distance.

Question 12
12(a) This question was intended to allow candidates to compare the relative risks of radioactive waste in the fly-ash from coal-burning power stations and the nuclear waste from nuclear power stations. Marks here tended to be earned from the generic marks explaining why radioactive materials introduce risk, and also from the fact that coal-burning power stations produce carbon dioxide, a green house gas (this had to be allowed as a legitimate answer as the question asked for 'the different problems associated with the waste' not '…with the radioactive waste'). A surprisingly large number made no reference to the first sentence in the stem and stated 'coal-burning power stations do not produce radioactive waste.'

12(b) The calculation in this question had a high omit rate; this is probably due to a combination of two factors – it involved a multi-stage calculation and it is the last question in the paper. As in questions 2(a)(i) and 8, candidates who laid out their work systematically had a better chance of getting marks as it was clear which stages of the process they had managed correctly. A large number omitted to scale up for 24 hours, or to scale up for 1200 MW – each of these approaches, if done correctly in other aspects, gained 2 of the 3 marks.

A182/01 Physics A Modules P4, P5, P6 (Foundation Tier)

General Comments:

This paper performed very similarly to its predecessors, with about half of the candidates earning at least half of the marks.

Candidates fared better with the six-mark questions that in previous years; centres have clearly been giving them practice at this type of question.

There were a variety of question formats included in the paper. There was some evidence that candidates were making up their own mind about how to fill in the table, draw the lines or tick the boxes, instead of reading the instructions carefully.

Many candidates were not using the mark and space allocation as guide for content of their answer, writing at length about one aspect, when they needed to write about more than one to earn full marks.

The use of specialist vocabulary in the context of radioactivity proved to be challenging for many candidates, both strong and weak. Their understanding of terms such as source, half-life, irradiation, contamination and waste was generally poor.

Comments on Individual Questions:

Question 1
1(a) Less than half of the candidates correctly identified the way to calculate gravitational potential energy for this part, many confusing mass with weight.

1(b)(i) The vast majority of candidates knew that gravity provided the downwards force on the cat for this part of the question.

1(b)(ii) Only half the candidates correctly stated kinetic energy as the answer, with gravitational potential energy being a very popular incorrect answer.

1(c) Only a minority of candidates realised that energy was conserved as the pot fell to the floor in this part.

1(d) Most candidates knew that the balls had different kinetic energy in part (d) because of their different masses, only a minority were able to satisfactorily explain why they had the same speed.

Question 2
Most candidates scored at least half of the marks in this question about a bike ride.

2(a) Most candidates ignored the instruction that they could put more than one tick in each row, this led to the majority of candidates earning only two marks.

2(b) The speed-time graph proved to be straightforward for strong candidates, although many did not draw a horizontal line for the central section where the speed was constant. Many weak candidates seemed to be drawing a distance-time graph instead.

2(c)(i) About half the candidates could correctly name the counter force on the bicycle and knew that it had to be exactly the same as the driving force for part **(c)(ii)**. As expected, weak candidates wanted the driving force to be slightly larger than the counter force for a constant speed.

Question 3
This question also appeared on the Higher Tier paper, so was expected to be accessible only to candidates operating at grades D and C. In practice, many candidates managed to earn half marks by discussing the different amounts of friction between the tyre and road in normal and icy conditions. Few were able to draw the correct force arrows on the diagram, let alone identify the interaction pair of forces responsible for the forward motion of the car.

Question 4
4(a)(i) Although few candidates earned both marks for part (a)(i), many earned one, usually for mentioning that copper is a conductor, the circuit was complete or it contained a battery. Too many candidates seemed to ignore the mark allocation and writing space provided, writing only a single statement which could only earn one mark.

4(a)(ii) Candidates fared much better with this part; most candidates correctly suggested adding another battery.

4(b) This was very poorly answered; few candidates mentioned the lack of free electrons or that plastic was an insulator, with many repeating the stem and saying that plastic is not a conductor.

Question 5
Most candidates were able to correctly identify all of the electrical circuit symbols in this question; some candidates confused the fixed and variable resistor.

Question 6
Many candidates struggled to earn marks in this question about electric motors.

6(a)(i) Strong candidates could correctly draw a force arrow for this part of the question but weaker candidates either got the direction upside down or from one pole to the other.

6(a)(ii) Almost no candidates scored any marks for this part, with most of them ignoring the current in the magnetic field and explaining that the forces were necessary for the motor to spin round.

6 (b) This question was extremely challenging for candidates with too many assuming that the motor was a generator.

Question 7
This six-mark question assessed about Ideas in Science, and was well answered by many candidates. Few candidates suggested the use of a thermometer to measure the temperature, and many assumed that being able to draw a graph of the existing pair of results was enough to confirm the correlation.

Question 8
This question about radioactivity proved to be quite hard, with only a minority of candidates earning at least half of the marks.

8(a) Many candidates confused “source of” with “type of” and named an ionising radiation rather than a source.

8(b) Strong candidates correctly identified both types of ionising radiation.

8(c)(i) Candidates were able to explain why the graph showed that the half-life was 5 minutes. Interestingly, many weak candidates assumed that since the graph stopped at 12 minutes, this was the lifetime of the sample, leading to a half-life of 6 minutes.

8(c)(i) Most candidates agreed that the source was safe after 10 minutes, showing that they had good skills at reading data off graphs.

8(d) Only a small minority of candidates were able to explain the meanings of the terms “irradiation” and “contamination” in the context of radioactive safety.

Question 9

The majority of candidates correctly identified all three particles in the atom of part **(a)** and the name of the process generating helium in the Sun for part **(b)**.

9(c) Only half of the candidates correctly linked each type of waste to its method of its disposal; most knew what to do with high level waste, but many confused the treatment for low and intermediate waste.

9(d) Few candidates were able to answer this question about the proposal to put radioactive waste in space, with many concerned that this would contaminate space and spoil it for us if we needed to be there some time in the future.

Question 10

This question about the risks and benefits of X-ray treatment was well answered by many candidates. A significant number of candidates didn't use the data provided at all, contenting themselves with a general account of the risks and benefit of X-ray imaging of people, restricting the number of marks that they could earn.

A182/02 Physics A Modules P4, P5, P6 (Higher Tier)

General Comments:

There were very few 'no response' answers indicating that candidates were able to complete the paper in the time allowed.

Candidates' answers showed that most had been entered by Centres for the appropriate tier paper and that they had been prepared for the style of questions included in the paper.

The six-mark extended-writing questions were, generally, attempted by all candidates, with few 'no response' answers. Some candidates limited themselves to the level that they could obtain by only addressing one aspect of the question, others wrote overly long answers, which included many irrelevant details, and were poorly organised and did not display good quality of communication. Well-planned and concise answers commenting on all parts of the question are more likely to achieve a higher level.

Answers requiring explanation, candidates often displayed some idea of the physical principles involved but often made contradictory comments. The frequent use of the word 'it' in such answers made some answers unclear as it was difficult to know to what the candidate was referring. Candidates need to express their ideas more explicitly.

There was evidence that candidates coped with the mathematical demands of the questions. Some candidates did not show their working and consequently where their answer was incorrect they could not be given any compensatory marks. Where data is given in a question they should be used in the answer. Some candidates did not refer to the relationships given at the front of the paper and either wrote them wrongly or did not use them in their answer.

The electricity section (module 5) was generally poorly answered.

Comments on Individual Questions:

Question 1
This question required candidates to perform calculations involving energy, momentum and resultant force as well as commenting on statements about speed and kinetic energy of falling bodies. Most candidates achieved 4 or 5 marks, usually on parts (a), (b)(i) and (b)(ii). Answers to part (c) were often contradictory.

1(a) Most candidates chose the correct option.

1(b)(i) The vast majority of candidates calculated the momentum correctly.

1(b)(ii) The majority of candidates performed the correct calculation. The most common wrong answers involved a failure to realise that the answer to part (b)(i) should be used.

1(b)(iii) Not all candidates understood that 'explain' means more than just saying what happens to the resultant force and were not prompted by the beginning of the question where the time to stop was restated. The most common misconception was that the can bounced and hence the resultant force was smaller as it took longer to stop. A variety of answers were seen with various combinations of increased/decreased resultant force and shorter/longer time to stop. There was no evidence that candidates used the relationship between change of momentum and resultant force given at the front of the paper. Some candidates did not gain any credit because they used terms such as 'harder' to describe the change in the resultant force instead of 'increased'.

1(c) This question was poorly answered by most candidates. A significant number of candidates thought they had to choose between George and Kate, or that both were correct. Many contradictions were seen in answers. Common misconceptions were: that gravitational potential energy was the same for both balls at the start; that they reached terminal velocity; that heavier objects fall faster. Some candidates discussed momentum rather than kinetic energy and speed. The best answers were supported by referring to the relationships at the front of the paper. Some candidates quoted the relationship/s but made no reference to it/them in their answer; others misquoted the relationship/s.

Question 2
This question was generally answered well. It required candidates to interpret a displacement-time graph.

2(a) The majority of candidates completed all lines of the table correctly. The middle row was the one most commonly incorrect.

2(b) Most candidates did not choose the correct option. The most common choice was the top left graph.

2(c) The majority of candidates drew a correct sketch graph. Some candidates did not attain both marks due to careless drawing such as not starting the line at 0 velocity or not continuing the line to the dotted line.

Question 3
Many candidates met the criteria to be awarded a level 1 or 2, by correctly discussing the role of friction and the grip between the tyres and the road. Only a few candidates were able to give a clear account of the interactive pair of forces which make the car move. Where arrows were drawn on the diagram they were often in the wrong direction or on the wrong body and not equal in length. Many candidates included weight of the car, reaction of the road and the drag force in their answer and some thought the engine provided a thrust force like a jet engine. These answers usually became quite confused. Many answers were not well organised and candidates wrote as much as they could about forces, much of which was not relevant to the question.

Question 4
Candidates found this whole question challenging. The majority of candidates attained 2 marks usually from part (a) and one of part (b).

4(a) The majority of candidates were able to draw the symbol correctly for an ammeter and put it in series with the resistor. Although the voltmeter symbol was drawn correctly its positioning was often incorrect, usually in series with the ammeter and resistor. Some candidates failed to get any marks as their symbols were incorrectly drawn, some as boxes.

4(b) Very few candidates gave correct choices for all three parts of this question. Part (iii) was the one most candidates chose wrongly. Often parts (ii) and (iii) were interchanged.

4(c) The majority of candidates failed to achieve any marks for this part. The action of an LDR is not known by many candidates. The most common misconception was that an LDR acted like a solar cell and put voltage into the circuit. Those candidates who correctly stated that the resistance of the LDR decreased when light was shone on it usually went on to say that the current increased but were not able to reason why the voltage across the resistor increased.

Question 5
The majority of candidates achieved at least level 2 when responding to this question, as they commented on both statements and used the data to support one of their comments. Usually the data were used to say why Pat was wrong, but a few candidates confused correlation with proportionality. A much smaller number of candidates used the data to calculate at least two values of resistance to explain why Chris was wrong. Some candidates described a mechanism to support their comment on Chris's statement rather than, as instructed in the question, the data and consequently did not receive credit for this.

Question 6
This question was poorly answered. The function of the commutator was not known and many confused a motor with a generator. Most candidates achieved 2 or more marks.

6(a)(i) Most candidates drew a clear vertical arrow downwards. A small number drew it too far away from side CD.

6(a)(ii) Some answers confused the motor with a generator and others misunderstood what the question was asking as their answers gave the purpose of the forces to turn the coil. Magnets were quite often mentioned but not the magnetic field. Many answers lacked clarity and the use of the appropriate scientific terminology. Some candidates described the forces as an interactive pair.

6(b) Less than half the candidates achieved any marks on this part. There was confusion again with a generator. Vague references were made to something changing direction, though some thought it was the coil or the magnets. Very few candidates gave a clear and full description of the function of the commutator.

Question 7
Parts of this question were answered well and the majority of candidates achieved at least 4 marks.

7(a) The idea of contamination was better known and described than irradiation. Many answers were vague as the candidate did not distinguish between or confused the source and radiation. A common misconception was that contamination is radiation inside a body whereas irradiation only happens outside.

7(b)(i) Most answers were not given credit as the curve of best fit either had too many points on one side, or it was not a single line or it was not smooth. Candidates need to take more care when drawing lines on graphs. Very often the three points at the end were either ignored or the line was placed well below them.

7(b)(ii) Most answers fell within the tolerance given in the mark scheme. A few candidates wrote the time as seen on a stopwatch e.g. 5.30 meaning 5.5, others gave the activity e.g. 62 instead of the time.

7(c)(i) Some answers gave sources of background radiation rather than what it is.

7(c)(ii) About half the candidates obtained an answer within the values in the mark scheme. Some of those giving an incorrect answer were able to gain a compensatory mark by showing appropriate working.

Question 8
Only a minority of candidates achieved more than 2 marks. The action of the control rods was not known and most candidates could not complete the nuclear decay equations.

8(a)(i) Many candidates showed an understanding of the term 'chain reaction' but failed to achieve the mark as their answers were too general about the process repeating and they did not state that more neutrons are produced.

8(a)(ii) The action of the control rods was not well known. Some incorrect answers were about temperature control or changing the seed of the neutrons.

8(b) The representation of alpha and beta particles was not known by most candidates. Those who did know went on to correctly balance the equations. The nuclear representation of alpha was better known than beta.

8(c) Most candidates gave one reason, which was usually the consequence of a nuclear accident such as irradiation or causing illness such as cancer. Very few candidates gave more than one reason. Only a few candidates mentioned perceived risk or that Ali was not in control.

Question 9

This question was answered well by many candidates. The majority obtained at least level 2 and answered both parts of the question about risks and safety procedures. A few candidates limited the level they could achieve by not giving more than one risk or not mentioning any. The way in which long handled tongs reduce the risks was usually well explained. Gloves stopping radiation was not always linked to alpha. Quite a number of candidates thought the monitoring badge acted like a GM tube or that it was some sort of security pass or a warning to other people. A few candidates wrote about nuclear waste or went through the penetrative power of each type of radiation without linking these to the precautions in the question.

A183/01 – Physics A Module P7 (Foundation Tier)

General Comments:

The paper examined knowledge and understanding of Physics module P7.

The paper was generally well attempted and produced a good spread of marks across most of the questions with typical scores ranging from single figures up to the low fifties. Candidate performance this year was weaker than 2014 which may indicate a more demanding exam but it is likely that many more borderline candidates were entered for the higher tier paper.

Candidates demonstrated a range of skills in their responses. Many candidates are now clearly at ease in responding to the tasks set by the extended-writing questions. Although the parallax question, which required a diagram, was an exception. Strong candidates make links between the different aspects described in the question stem. These questions differentiate well. Candidates who achieve well on these questions generally perform well on the paper as a whole. There is a tendency amongst weaker candidates however, to provide rehearsed answers from previous examination questions.

Candidates were able to interpret and evaluate data, in a variety of formats, appropriately in calculations and comparisons. The most able candidates were also able to recall correct scientific terminology, apply abstract ideas about parallax measurements and describe a sequence in the formation of a protostar. Candidates were given opportunities to apply Ideas about Science (IaS), describe, explain and draw conclusions. Objective questions provided opportunities to test comprehension and recall.

Three issues for teaching emerge however. Firstly, many candidates lack the skills to draw and clearly label scientific diagrams. Secondly, few candidates seem to understand what is meant when they have to justify an answer they have given, and thirdly ideas about confirming or checking measurements are often confused with ideas about accuracy, precision and averaging.

Comments on Individual Questions:

Question 1

1(a) Candidates were asked to draw how a mirror brings parallel light to a focal point. Candidates found this difficult. Weak diagram drawing skills meant that some candidates could not draw parallel lines with sufficient accuracy. Many candidates drew refraction through a lens.

1(b) Most candidates could identify ‘reflection’ as the name for what happens to light at a mirror, select explanations in part **(c)** why mirrors are used in telescopes and (even more) select the properties of large telescopes in part **(d)**.

1(e) Few candidates were unable to calculate the power of the lens with focal length 2m.

Question 2

This extended response 6-mark question asked candidates to describe how a protostar forms and what happens to the gas particles, to include ideas about temperature, pressure and volume. The common misconception between the nebula and the protostar meant that many candidates were confused about whether the volume was increasing or decreasing. Many good descriptions of the effect of gravity on pressure and temperature changes in the hydrogen cloud were seen. The kinetics of the gas particles were rarely described. Fusion was frequently described but many candidates described the fusion of hydrogen with helium.

Question 3
3(a)(i) Most candidates identified the correct apparent movement of the Sun, Moon and stars and even more gave a correct explanation for this in part **(a)(ii)**.

3(a)(iii) Very few candidates used the term 'correlation' when answering this question. They may not have understood the question 'Do the data show a relationship?' as most were able to describe the relationship, which was the 'justify your answer' part of the question. Common misconceptions about time and speed meant that weaker candidates missed a mark for identifying distance and time as the variables.

3(b)(i) Most candidates could plot the point for Earth but few were able to plot the point for Mars to the required ½ small square accuracy. However, most were able to draw and use an accurate best fit line in parts **(b)(ii)** and **(b)(iii)**.

Question 4
4(a) Candidates were required to select four words from a choice of five to complete a passage describing how Cepheid variables are used to determine distances to galaxies. Strong candidates had few problems with this, though many considered that 'shape' was the correct linking idea to the period or the luminosity. Weaker candidates could generally only link 'brightness' to 'observed'.

4(b)(i) The majority of candidates achieved both marks for this part, calculating the mean distance (four numbers, each to 2 d.p), with a majority able to use their answer to identify the correct galaxy containing the C-V in part **(b)(ii)**.

4(b)(iii) Only a minority of candidates could select the correct value of the number of parsecs in a megaparsec.

4(c) Most were able to apply the speed of recession formula in part (c).

Question 5
This extended response 6-mark question asked candidates to describe how parallax is used to measure the distance to nearby stars and include a labelled diagram in their answer. This was a difficult question for the candidates. Examiners were looking to give credit for responses that showed an idea that an angle was involved, an idea of a baseline – ideally opposite ends of Earth's orbit, but Earth's diameter was allowed, and an idea of relative movement. This last idea, that observations are compared against a background of stars was least secure in candidates understanding. Many, who scored any marks, gave the angle idea. For the baseline, some even described using their thumb to find the distance to the star. As with question 1(a), diagrams were often weak, with little care or precision in their construction and labelling was often absent. Even the most basic diagram would have given an idea of a triangle with a baseline for which some marks would have been gained.

Question 6
6(a) Candidates were asked about some repeated readings of a series of pulses detected by a radio telescope. More than half the candidate's responses reveal confusion about the confidence that the scientist has in her observations and the accuracy of those observations.

6(b) For the answer to this question few were able to cite the additional evidence, given in the question stem.

6(c)(i) Candidates generally linked a yes/no conclusion to an advantage or a disadvantage, often considering both but not always gaining credit for some of their ideas. In parts **(c)(ii)** and **(c)(iii)** a large number of candidates demonstrated genuine confusion regarding the evidence for extra-terrestrial life. In the syllabus this is a recall statement yet most candidates were compelled to invent something in part (c)(ii) and provide an imaginative supporting argument in part (c)(iii). Knowledge of the discoveries of extra-solar planets is clearly not secure at this level.

6(d) Only a small number of the most able candidates recalled that neutron stars were the remains of supernovae. The question had a high omit rate indicating unfamiliarity with the term. Most candidates, who attempted the question, described star formation in nebulae.

Question 7

This extended response 6-mark question, common with the higher tier paper, asked candidates to explain why observatories are built on isolated high mountains, considering the advantages and disadvantages and suggesting, with a justification, an alternative location. There were many well developed answers to this question describing and explaining the advantages and disadvantages of putting telescopes on the tops of mountains. However, possibly because this was the last question, many able candidates did not address the task of suggesting an alternative location. Of those that did address this aspect of the question, very few recalled that telescopes in space had greater advantages and overcame many of the disadvantages of mountain based telescopes.

A183/02 – Physics A Module 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. Candidates who are entered inappropriately to the higher tier are often unable to access questions and have very limited opportunities to demonstrate what they know. 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 a noticeable increase in the number of candidates writing on continuation sheets. This should only be necessary in rare cases. The space provided for answers being an indication of the depth of answer required. Most candidates who used extra sheets were simply repeating information from the stem of the question. Conciseness is desirable in answers, particularly the 6 mark questions which also assess the quality of written communication. With most filling the available space with writing.

Candidates did not always read the full question in the 6-mark extend prose questions and as a consequence only addressed part of the question, often limiting the marks available to them. Some practice in planning answers to the 6 mark questions might be helpful.

Many candidates did not have the mathematical skills required for the higher paper, this was particularly apparent in Q3, where the weaker candidates were often at a loss as to how to address the question.

Comments on Individual Questions:

Question 1
1(a) Answered very well by most candidates, if they did not receive the mark they have usually referred to accuracy. Many candidates do not know the differences between accuracy and reliability.

1(b) Most candidates correctly said another telescope

1(c)(i) Most candidates got the communication mark and the potential danger, they mainly lost the mark by not having a conclusion. Often there was just a list of advantages and disadvantages.

1(c)(ii) Very few said no evidence, the most common answers were the wow signal, UFO's, lots of space junk and footprints on Mars!

1(c)(iii) Whilst many knew that extra solar planets had been found, many were unclear about the nature of the plants with many suggestions of water found on these planets. Many fanciful ideas were repeated from part (c)(i) e.g. UFOs.

1(d) Answered well with most candidates referred to super giant and the remains of a supernova. Most common weak responses described the formation of a proto star.

Question 2
2(a) This question was well answered by most candidates, the most common error was Canada.

2(b) Most responses contained several good advantages and some disadvantages but missed out on giving an appropriate alternative location. It was common for candidates to fill the space with advantages rather than dividing the space provided into the 3 sections required by the question. Candidates would benefit from practice in planning the answers to the 6 mark questions.

Question 3
3(a) This question was generally not answered well. The most common error was to draw a straight line for the line of best fit, when the points were clearly forming a curve. Other common errors were incorrect labelling of axes e.g. no units or poor choices of scale e.g. 10 squares = 0.3. In general plotting was good.

3(b)(i) This was not answered well by most candidates. Few were able to describe the features of the graph that showed it was directly proportional. A common response was to give examples of data points without describing the general features. It seemed that weaker candidates didn't understand the question at all.

3(b)(ii) Many candidates started the calculations, but then got lost. Most candidates who got at least one mark for getting to 1.95, but failing to use this value to find T.

3(c)(i) Most candidates could calculate the square and cube values. However, a large proportion of candidates did not understand what was meant by 3 significant figures.

3(c)(ii) Candidates often used appropriate maths but then failed to indicate that their two results were similar and hence fitted Kepler's relationship. Most candidates who got the marks did say both numbers were close, some candidates did work the ratio of the 2 numbers and stated this was the same as for Kepler's relationship.

3(d) Most candidates identified the correlation as distance increases as time decreases, however, hardly any mentioned the need for a mechanism or explanation. Few could explain what was required for a causal link. A common error was misread causal as a 'casual' link. Weaker candidates stated there was no correlation because 'one went down as the other went up'.

Question 4
The best responses wrote short sections on each method, clearly identifying the key features. Weak responses made vague statements about methods, often containing incorrect physics. It was not uncommon to see candidates including information that featured in previous papers rather than applying their knowledge to the current question. Links between the three methods were often missing or simply said that Hubble depends on the other two, with no further explanation. A common misconception had Hubble the wrong way round so they wanted to measure distance with Cepheid variables and the use Hubble to calculate speed of recession.

Question 5
5(a) Most common answers were moving towards the supergiant part from some part of the main sequence but most then incorrectly curled back towards the white dwarfs, very few stopped at the supergiant region.

5(b) By far the most common error was to start with hydrogen followed by helium. Otherwise this was generally well answered.

5(c)(i) This was a demanding question with some strong distractors, the most common errors were 'photons turn into electrons in atoms' and 'the colour of the electron depends upon the photon'.

5(c)(ii) This question was generally answered well with the most common error being that candidates circled one answer, the most common incorrect responses were 19 and 32.

5(d)(i) and **d)(ii)** were essentially recall and incorrect answers did not seem to bear any relationship to the question, simply illustrating that the energy transfers were not known.

5(d)(iii) This question was usually answered quite well. Common errors included adding the 273 and incorrectly recalling the value as 237.

Question 6
Responses that gave the correct sequence were likely to gain top of level 2 and showed a good understanding of the processes involved. Weak responses often made unrelated statements or stated links between quantities with no reference to the formation of a star. The best responses were able to write a clear, non-contradictory ‘story’ which referenced the mathematical relationship within the prose. Unfortunately, many candidates just quoted formulas linking P,V and T without relating these to the context.

A184 – Investigation Controlled Assessment

Comments:

Overview
This was the third session for the assessment of the 21C Science suites Investigation controlled assessment. It was a real pleasure to see how most centres had responded to advice and guidance from previous years. A significant proportion of centres still had their marks altered this session. The most common cause of significant changes to centres marks still relates to the hierarchical nature of the marking criteria, details of which are addressed below.

A serious cause for concern was the increase in malpractice cases. These nearly always involved centres who are giving too much guidance or feedback. They are giving too much guidance because all candidates are following same methods, same limitations and improvements, same references, etc.

Candidates' scripts from a small number of Centres were overly long, although timings indicated in the specification are for guidance only; it was clear that in some instances these had been exceeded markedly to the extent that in some instances this was malpractice. Candidates should not be allowed unreasonable amounts of time and it should be impressed upon candidates that producing reports is an exercise in conciseness.

Administration
A significant number of centres entered candidates for the wrong component, significantly delaying the requesting of manuscripts. Please note that the suffix /01 is for entry via the repository (i.e. electronic copies of candidates work) and the suffix /02 is for the normal postal moderation.

Documentary evidence of internal standardisation was also supplied in a large number of instances, but for many Centres, this was not provided. Much inconsistent marking seen suggested that internal standardisation procedures had not been applied by some Centres, and Centres are reminded of their obligations:

'It is important that all internal assessors of this Controlled Assessment work to common standards. Centres must ensure that the internal standardisation of marks across assessors and teaching groups takes place using an appropriate procedure.' Section 5 of the specifications suggests some ways in which this can be carried out.

In general the provision of samples was very good, with work sent promptly with all the correct administrative documents. When not correct the most common omission was the CCS160 Centre Declaration although a number of centres failed to attach the Coursework cover sheet to the front of each candidate's work, which always causes problems to the moderator. When submitting samples please <u>do not</u> use plastic wallets, the preferred method for holding a candidates work together is treasury tags. There were few clerical errors this session, but where they did occur they were nearly always the result of careless addition or transcription of marks.

Few Centres provided their Moderator with detailed accounts of how the tasks and levels of control were administered; where present, these aided the moderation process.

Annotation
Annotation of candidates' work was excellent in many instances, but variable from Centre to Centre, and sometimes within a Centre. The annotation ranged from *just a series of ticks here and there* to *the relevant skill area code written adjacent to where the point had been made, backed up by a supporting comment.* We would always encourage centres to adopt the latter of

the two approaches. Please note that it is a requirement that 'each piece of internally assessed work should show how the marks have been awarded in relation to the marking criteria'.

Hierarchy
A significant number of centres did not treat the criteria as hierarchical. Where this was the case centres were often significantly out of tolerance. Each statement at a lower mark must be met before marks can be awarded at a higher level. So for example all the criteria at 1-2 marks need to be met before 3-4 marks can be awarded.

When marking the work each criterion should be annotated where it is met. Beginning with the lowest level and working up to the level where a criterion is not met. This will determine the level of marks awarded. If the candidate meets all the criteria a given level then the higher of the two marks is awarded. Where the candidate meets some of the criteria in a level the lower of the two marks must be awarded.

For example, in strand **Eb** a candidate who fails to make any comments about outliers is limited to a maximum of 3 marks no matter how well they consider the degree of scatter and general pattern of results. A consequence of this is that it is important that:

- candidates are taught to address lower level criteria as well as higher level criteria.
- teachers take care in identifying where the criteria are met otherwise quite large alterations in marks may result during moderation.

Particular criteria that have not been addressed by candidates are identified below.

Interpretation of assessment criteria
Sa – formulating a hypothesis or prediction
For 21C Sciences a scientific hypothesis is a tentative explanation of science related observations or some phenomenon or event. The key point here is the idea of the explanation. A useful hypothesis allows a prediction to be made from it that can be tested experimentally.

The most common difficulties here were insufficient science used to develop the hypothesis. A common mistake was to provide 'a large chunk' of scientific knowledge but not relating this clearly to the development of the hypothesis.

Secondly, major factors were not considered before selecting a factor for the development of the hypothesis. It is not sufficient to state a factor, give a hypothesis and then list other factors as control variables. Candidates are recommended to structure their reports to make this process clear.

At the highest levels, 7-8 marks, it is important that candidates consider all relevant factors prior to selecting one. A quantitative predication must be derived or related to the hypothesis not simply an unjustified guess.

It is worth mentioning that work in this strand may not be credited for work in strands Ra or Rb which are carried out under conditions of high control.

Sb – Design of techniques and choice of equipment

In this session, this strand was often generously marked. It was often not possible to justify the centre marks because students limited themselves to a maximum of 5 marks by failing to explain their chosen range of data. It was disappointing to find that the range (of the independent variable) was rarely explained. Centres seemed to believe that just ‘stating’ the range was sufficient. This explanation can be pragmatic, 'there were only 5 different strength lens available', based on safety issues, 'the upper end of the range was limited to 2M as any more concentrated would be too corrosive' or based on prior knowledge/preliminary work 'from PE I know students cannot do step ups steadily for more than 3 minutes' or 'my preliminary work showed a reasonable change in the dependent variable of this range'. Note both ends of the range should be mentioned.

Good scientific justifications of the method, equipment and techniques selected must be provided for candidates to be awarded marks in the 7-8 mark level. Some candidates carried out preliminary work prior to the experiment proper. Although not a requirement, if it is practicable to do so in the allotted time, this can help to candidates to justify the method, equipment or range used. Justifications, however, were often weak, and the reasons for the use of a particular method, in particular, were often not provided. Many candidates produced tables, ostensibly to justify the equipment used, but these often listed every piece and simply described how they were used rather than justifying the choice. At this 7-8 mark level, candidates should be using terminology such as ‘resolution’, ‘accuracy’ and ‘precision’ in their justifications.

In this strand, candidates are also required to review aspects of Health and Safety, ranging from comments, through to producing full and appropriate Risk Assessments. These were sometimes absent, and where a high mark had been awarded, Centre marks had to be lowered significantly. It is suggested that there is no excuse for omitting Risk Assessments; this phase of the task is under limited control, and more importantly, a Risk Assessment is a prerequisite to any practical work being carried out. Risk Assessment proformas can be used, and these should include the chemical, organism, piece of equipment or activity that is likely to constitute a hazard, the hazard defined (using the appropriate terminology), the associated risk(s), and measures intended to reduce risk. Risk Assessments should pertain to the experiment in question and not to generic hazards and risks (though clearly, candidates are not penalised for the inclusion of these).

Please also note the hierarchy of awarding marks here; hazards must be identified for 3-4 marks, with ’some precautions’ to minimise risk for 5-6 marks. While the word ‘some’ is used, it was not possible to support Centre marks where arguably the most important safety precautions are omitted e.g. the use of low voltage power supplies in electrical experiments. For 7-8 marks, for a Risk Assessment to be ‘full’, it must refer to *all* potential hazards and risks. This includes such things as using low voltage power supplies, limiting concentrations of solutions and the source of biological materials. Here, candidates should be encouraged to use statements such as ‘low hazard’ and ‘limited risk’. Candidates should also consider hazards and risks of a final product of the experiment, e.g. the products of a chemical reaction or incubated agar plate. For a Risk Assessment to be ‘appropriate’, the hazard/risk must be appropriate to that for the chemical/equipment/activity used or undertaken. At this level they should ideally refer to PAT testing of electrical equipment, COSSH, Cleapps Hazard cards or other similar documents and show an awareness of who/where the first aider is in case of injury.

C – Range and quality of primary data
Errors in marking in this strand tended to be at the higher end. The '*correctly recording of data'* at the 5-6 mark level requires meaningful column headings, correct units and consistency in the number of significant figures/decimal places used. To match 6 marks, candidates need to show consistency both with the number of decimal places reported for their raw data and the actual measuring instrument as well as including all quantities and units in table headings.

In strand C there is no need to do more than 2 sets of results if there is close agreement between the two sets obtained. If they are not close, however, then there is a need to do a further repeat for this value –an intelligent repeat. The *regular repeats or checks for repeatability* criterion would then be matched and a possible outlier could be identified. In the new (2011/2012) specifications for Twenty First Century Science, statement 1.6 in the 'Ideas about Science' has clarified the definition and treatment of outliers (compared with the version in the legacy (2006) specifications) to state, *"If a measurement lies well outside the range within which the others in a set of repeats lie, or is off a graph line on which the others lie, this is a sign that it may be incorrect. If possible, it should be checked. If not, it should be used unless there is a specific reason to doubt its accuracy."* Potential outliers in data collected during a Controlled Assessment should be handled in accordance with this statement, with the expectation that at this stage the measurement will be repeated/checked.

Please note that experiments that 'pool' data from a class are not suitable for this controlled assessment. Strand **C** is based on the primary data collected by the candidate. Data collected by other candidates is secondary data. It is very likely that a student pooling data with other students in a class will be limited to the 1-2 mark level.

A – Revealing patterns in data
Overall, the quality of work in this strand was disappointing. Arguably, this should have been the strand of the Practical Data Analysis where candidates scored the highest marks, but it was here where often the largest discrepancies between Centre and Moderator marks occurred.

Some graphs seen were of poor quality. There was clear evidence that some Centres had not checked the plotting of points carefully before awarding marks. Graphs drawn without appropriate scales, e.g. where these were non-linear, or without one or more labelled axes, and poorly-drawn lines of best fit, were often, incorrectly, awarded high marks. If the scale is inappropriate, or points are plotted incorrectly, the candidate mark cannot exceed four. Likewise, if an inappropriate line of best fit has been applied, a mark above five cannot be awarded, irrespective of whether the candidate has drawn range bars. For marks to be awarded in the highest mark levels, range bars must be drawn accurately (in addition to there being minimal errors in the plotting of data). The scales chosen by candidates often made difficult accurate plotting of data, as did crosses drawn with unsharpened pencils, particularly where millimetre graph paper was used. Although it is not essential that graph scales should start at (0,0), where axes begin with a 'zig-zag' section it is important that candidates do not extend their line of best fit into this 'undefined' area. This bad practice was seen on a number of occasions.

Please note that if computer generated graphs are produced they will be marked in exactly the same way as hand drawn graphs. In particular the grid lines on the graph must allow the plotting to be checked to 2 significant figures.

In some instances, however, candidates that were awarded very low marks having drawn very poor graphs could be awarded three or four marks owing to their calculations of means, a point sometimes overlooked by Centres.

Centres are reminded that for candidates to be awarded marks at the 5-6 mark level and higher, graphs having gridlines should be produced. They should not be drawn on lined paper. Where computer software is used to generate graphs, these should have appropriate scales, appropriate labelling, and gridlines. For candidates to score high marks, lines of best fit and range bars should be drawn manually.

Ea – Evaluation of apparatus and procedures
This was generally well assessed by centres however the common errors consisted of over marking candidates who suggested improvements but did not consider the limitations, hence not meeting the criteria at 3-4 marks.

Some improvements mentioned were trivial or lacked the detail required for higher marks. In general doing more repeats is unlikely to be a significant improvement.

There was some confusion over improvements to the experimental procedure and apparatus which is addressed here in Ea and the additional data or methods which can be used to increase confidence in the hypothesis which falls in stand **Rb.**

Eb – Evaluation of primary data
A major stumbling point here was the requirement for outliers to be considered at level 3-4 marks. A significant number of centres ignored this requirement. In addition there appeared to be some confusion over what an outlier is, both amongst candidates and teachers. The criteria state *'individual results which are beyond the range of experimental error (are outliers)'*. Not all anomalous results are outliers, in particular averages are not outliers and a set of data points for a single value cannot all be outliers. In the new (2011/2012) specifications for Twenty First Century Science, statement 1.6 in the 'Ideas about Science' has clarified the definition and treatment of outliers (compared with the version in the legacy (2006) specifications) to state, *"If a measurement lies well outside the range within which the others in a set of repeats lie, or is off a graph line on which the others lie, this is a sign that it may be incorrect. If possible, it should be checked. If not, it should be used unless there is a specific reason to doubt its accuracy."* Potential outliers in data collected during a Controlled Assessment should be handled in accordance with this statement. Candidates are permitted to draw a graph of their results during the (limited control) data collection stage of the Controlled Assessment task. This may help them to identify potential outliers. Ideally, any data points that look to be potential outliers should be re-measured, and this is easiest to achieve if they are identified during the data collection session i.e. strand **C**.

For 5-6 marks, although there were some often good discussions of spread of data, 'repeatability' was not always discussed. Candidates should discuss the spread of data qualitatively at this level, and quantitatively to obtain the highest marks at the top mark level at 7-8 marks. Candidates' evaluations were often very long, but many covered the pertinent points in the first few sentences.

Ra – Collection and use of secondary data
This strand was poorly addressed by many candidates.

The intention in Strand Ra is that candidates should do some research and find their own examples of secondary data. The OCR data in the 'Information for candidates 2' document is only provided as a back-up for those who fail to find any relevant secondary data from their own research.

Generally candidates are limited to 5 marks in Strand Ra if all they use is the OCR data and/or results from another candidate or group. In order to access 6 or more marks in Strand Ra candidates must present a 'range of relevant secondary data', which means that some data from the candidate's own research must be included and the source(s) of the data must be fully referenced. Guidance on referencing can be found in the 'Guide to Controlled Assessment' handbook for Unit A154 / A164 / A174 / A184 (Practical Investigation). The direct download link is http://www.ocr.org.uk/Images/77479-guide-to-controlled-assessment.pdf

Secondary data can be of different types:

- the data provided by OCR in the 'Information for candidates 2' document;
- data collected by other candidates doing the same (or a similar) investigation;
- data from other sources (e.g. textbooks or the internet).

Data do not necessarily have to be quantitative; they can be qualitative. Students do not necessarily have to find a table of numbers that looks exactly like the one they have generated from their own experiment; graphs, descriptions of trends, conclusions, mathematical relationships, relevant constants, models and simulations can all be presented as secondary data.

It is helpful to the moderator if candidates included copies of the secondary data that they discuss in their report. This could be cut and pasted into the report (so long as it is clearly identified as third-party material), or may be attached to the end of the report. The material included should be carefully selected and cropped to show only the relevant parts, rather than comprising swathes of irrelevant material indiscriminately printed out.

Rb – Reviewing confidence in the hypothesis

This strand was also over-generously marked by some Centres. Candidates should be encouraged to re-state their hypothesis at the beginning of the review section to provide focus for this strand. Candidates often discussed findings but did not refer the hypothesis at all, or say if their data supported it. All candidates should make at least a statement referring to whether the hypothesis has been supported (or not), and the extent to which the data support the hypothesis.

At the 3-4 mark level upwards, candidates should make reference to some science when explaining their results. This was rarely done. It is not sufficient to merely refer to science used in Sa, as Sa is carried out under conditions of low control whereas Rb is done under high control conditions. At level 5-6 the science must be used to support the conclusion about the hypothesis.

When giving an account of extra data to be collected this must go beyond simply suggesting improvements to the procedure used, which is assessed in Ea. Different techniques or experiments that will provide additional data to assess the hypothesis are required for this strand.

Sources of Support

OCR offers several avenues of **free** support, including:

- A 'Guide to Controlled Assessment' handbook for Unit A154 / A164 / A174 / A184 (Practical Investigation). The direct download link is http://www.ocr.org.uk/Images/77479-guide-to-controlled-assessment.pdf
- INSET training events for 2013-14 are available details may be found on the OCR website at http://www.cpdhub.ocr.org.uk
- We offer a Controlled Assessment Consultancy service, in which candidate work that you have marked will be reviewed by a senior moderator prior to moderation.
  To make use of this service, post photocopies of three marked pieces of work to the following address: *Michelle Hawley, Science Team, OCR, 1 Hills Road, Cambridge, CB1 2EU*.

Typically, we encourage Centres to send work which covers a range of attainment or which illustrates particular points of concern. The Controlled Assessment scripts should be marked and annotated before being photocopied. Please include a covering note on Centre-headed paper, and give a contact email address. A senior moderator will look at the work and will write a report on the Centre marking, which we will email or post back to you within 6 weeks. You can then make adjustments to your marking, if you wish, before submitting marks for moderation in May.

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