OCR
RECOGNISING ACHIEVEMENT

GCSE

Physics A

Twenty First Century Science Suite

General Certificate of Secondary Education **J635**

Reports on the Units

June 2010

J635/R/10

Oxford Cambridge and RSA Examinations

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

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

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GCSE Twenty First Century Science – Physics A (J635)

REPORTS ON THE UNITS

Chief Examiner's Report

The number of candidates entered for the Physics A specification has continued to grow this year.

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 in general 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. However, one issue has been raised by examiners as becoming more prevalent. This is the legibility of candidates' handwriting. More candidates are losing marks because the examiner is unable to decipher what the candidate has written. This is the case on both higher and foundation tiers.

There is some evidence to suggest that more candidates are being inappropriately entered for the higher tier papers and that these candidates would benefit from entry to the foundation tier.

Principal Moderator's Report

General Comments:
The number of candidates being entered for this specification continues to be very large and the balance between the specifications continues to shift slightly towards a higher entry for the separate sciences compared to Science and Additional Science. The sampling procedures have been modified and streamlined this year in the light of new guidance from the Joint Council for Qualifications (JCQ).

As the interpretation and application of the assessment criteria has improved it is not surprising that the there has been an increase in the percentage of candidates achieving certain aspects of the assessment criteria. However, whilst there has been improvement in some areas, other aspects of the criteria continue to be demanding and challenging for candidates and the spread of marks over the cohort allows secure differentiation between grades.

This report will highlight those areas where there has been improvement and also those where there is still significant opportunity for development. The reports from 2008 and 2009 will still be available online at www.ocr.org.uk to provide further detailed guidance.

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

- Administrative issues
  - General comments
  - Annotation
  - Internal moderation
  - Type and context of assessed work
  - Nature of practical work
  - Candidate helpsheets and teacher review of coursework
  - Plagiarism
- Assessment and marking framework
  - Calculating the Strand mark
  - Marking strands I and P in Data Analysis and Investigations
  - OCR cover sheet for candidates' work
- Data Analysis
- Case Studies
- Investigations
- Grade Thresholds

Administrative issues

General comments

Those Centres that responded to the early introductory letter to establish an email contact between the Centre and the moderator improved the efficiency and effectiveness of the moderation process and this was much appreciated by moderators. However, there were still too many Centres who did not send the paperwork and coursework samples promptly by the OCR deadline. Centres that followed the advice on the checklist included with the introductory letter and provided all the relevant information, in particular details of how each of the tasks used for assessment had been introduced and presented to candidates, greatly facilitated the moderation process and helped moderators to support the marks awarded by the Centre.

Annotation

Too often there was little or no indication of how marks had been awarded. The minimum notation acceptable is to use the assessment criteria codes, eg I(b)6, at the appropriate point in candidates' work. For Case Studies it was noted that where Centres provided further commentary this was particularly helpful. Suitable annotation makes it more likely that the moderator will be able to support the mark awarded. However, it is important that annotations accurately reflect the criteria. In some cases, it was noted that the annotation was a very generous interpretation of the criteria and occasionally 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 more incidences of unsatisfactory internal moderation reported by the moderating team this year.

Type and context of assessed work

In line with guidance from the Joint Council for Qualifications (JCQ), coursework can be submitted for as many specifications as it is valid for. In the case of Twenty First Century Science, this means that it has to match both type (ie Data Analysis and Case Study or Practical 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. Please note that if the same piece of coursework is requested for moderation in more than one specification, then it must be photocopied and put into the appropriate coursework sample package.

Nature of Practical work
The Data Analysis and Practical 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 Practical 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.

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

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 document.

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

The following quotes are from this document:

> "Teachers may review coursework before it is handed in for final assessment ... ... provided that advice remains at the general level, enabling the candidate to take the initiative in making amendments …". "Having reviewed the candidate's coursework it is not acceptable for teachers to give, either to individual candidates or to groups, detailed advice and suggestions as to how the work may be improved in order to meet the assessment criteria. Examples of unacceptable assistance include detailed indication of errors or omissions, advice on specific improvements needed to meet the criteria, the provision of outlines, paragraph or section headings, or writing frames specific to the coursework task(s)."

Candidate help sheets of the generic type which are applicable to any task are allowed. Whilst helpful for lower achieving candidates these can restrict the opportunities for higher achieving candidates. There was evidence that some Centres were providing help sheets 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. Centre marks could not be supported by moderators 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. The JCQ document goes on to say: "These actions constitute malpractice, for which a penalty (eg disqualification from the examination) will be applied".

Assessment and marking framework

Calculating the Strand mark

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.

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. 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.

Three aspects of performance per Strand

Where there are three aspects for each of the Strands (which applies to all Strands except Strands B and C of the Case Study) the following examples illustrate how to convert aspects of performance marks into Strand marks.

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

Two aspects of performance per Strand (B and C of the Case Study)

From experience it is often best to consider both strands B and C together when arriving at the final strand mark for each. For example, if B(a) = 4, B(b) = 3, C(a) = 4 and C(b), then it would be appropriate to award B = 4 by rounding up and C= 3 by rounding down (or vice versa), for a total of 7 marks for these two strands taken together.

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

Marking 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 Practical Investigation. If there is some evidence for both approaches, then both should be marked with **the better of the two being counted (but not both marks)**. Some Centres counted both marks which produced an incorrect aggregate for the Strand.

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 Practical Investigations are of a quantitative nature and will provide evidence for the first and second rows. In these cases, the aspect mark will be determined by averaging the mark in these two rows only, ignoring the third row completely. For those rare investigations which include qualitative evidence but no quantitative evidence, the mark for Aspect b should be based on the average of the second and third rows only. Where averaging results in half marks, professional judgement should be used to determine the best fit mark of the two alternatives. Once the mark for aspect (b) has been decided, it can be combined with the marks for (a) and (c) to provide the average, and so the best fit mark, for the strand.

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

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

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

Candidate coversheet
All marks must be recorded on the OCR cover sheet which is attached to candidates' work. A number of Centres did not use the latest format of the OCR cover sheet or, in a very few cases, did not use a cover sheet at all.

Data Analysis

General comments
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. Work which is based purely on teacher demonstrations, computer simulations, given sets of results or similar is not acceptable.

Many Centres used whole class practical activities as a basis for Data Analysis exercises and this clearly worked well. Therefore it is very important that Centres include details of how the task was presented to their candidates eg briefing sheets etc. The better candidates included a description of their experimental method, their own results table and the class data set which made the marks awarded for evaluation easier to support.

It is most important that candidates record and present the data that they have collected and not just plot a graph or do numerical calculations without 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 Practical Investigations and the same marks for I and E from Practical investigations can be submitted for Data Analysis in another specification **provided the subject context is appropriate**. Many Centres used this opportunity to obtain the optimum marks for their candidates. In these cases, Centres must indicate this on the appropriate coversheet and also include copies of the work in both samples which are sent to the moderator, if the same candidate is selected.

Data Analysis tasks

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

Resistance of a wire	Stretching elastic bands, springs
Osmosis	Stopping distances of bicycles
Cooling curves	Clotting of milk
Crater impact	Bouncing of squash balls
Rates of reaction	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', and '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 repeated 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 average calculations 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 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 so that marks for E(b) can be awarded and their conclusion may be 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 carrying out a numerical analysis. Whilst many candidates now plot all their data and often include range bars, the quality of graph-drawing often shows a lack of care in plotting the points accurately, using suitable scales, labelling axes correctly and drawing a line of best fit accurately and carefully. Many members of the moderating team felt that the standard of graph-drawing had certainly not improved since last year. 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.

The following guidelines provide more guidance about what is required but they are 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 line of best fit.
- I(a) 6 - graph with correctly plotted points, correctly labelled and scaled axes and correctly drawn line of best fit.
- 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 such as box and whisker plots. 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 for hand-drawn graphs 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 line of best fit

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 whether 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 was not 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 much 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 really 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. Many candidates suggested possible improvements to match E(a)6 although they 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, 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 range and 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, as well as detailed suggestions about 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 could only apply to the range of values that were studied because outside this range, other factors may act. For example, in chemical reactions the rate is bound to slow down as one of the chemicals gets used up, rubber bands that are stretched will eventually break, more exercise cannot always mean that pulse rate continues to increase etc.

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', and '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 but many still tend to present a report describing a topic rather than collect evidence for both sides of a case and use their own judgements to derive a personal conclusion. There is, of course, not always a right or wrong answer in these controversial issues and marks are awarded for the way that the candidate has presented and argued the case.
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, rather than just eliciting a yes/no response, 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?
MRSA – is hospital the best place to be when you are ill?
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 could be regarded as plagiarising material and risk incurring 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 the better 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, should 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 are appropriate. 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 were given. For 4 marks it is expected that candidates include some information about the nature, purpose or sponsorship of the website. Candidates should also be encouraged to 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

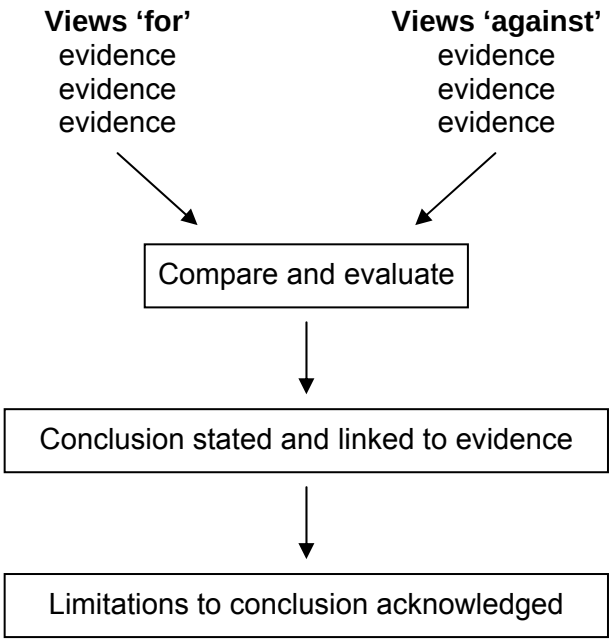
The majority of candidates described the relevant background science in the introduction to their Case Studies. However, it was only the most able who could integrate their scientific knowledge and understanding with the claims and opinions reported in their studies or extend the scientific knowledge 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 Twenty First Century Science specifications about Science Explanations and the Ideas about Science, and also the published OCR exemplars to know in advance about 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 seventh or eighth mark will come either for applying and integrating this correctly to the case, or for finding and explaining some additional science related to their Case Study.

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 looked 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, considering its significance, importance and reliability and using their own judgement to arrive at a suitable conclusion on a controversial issue. There was evidence that many candidates were not using and applying their Ideas about Science sufficiently, particularly IaS 5, to warrant the higher marks in this strand.

Those Centres who had 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.



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); 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

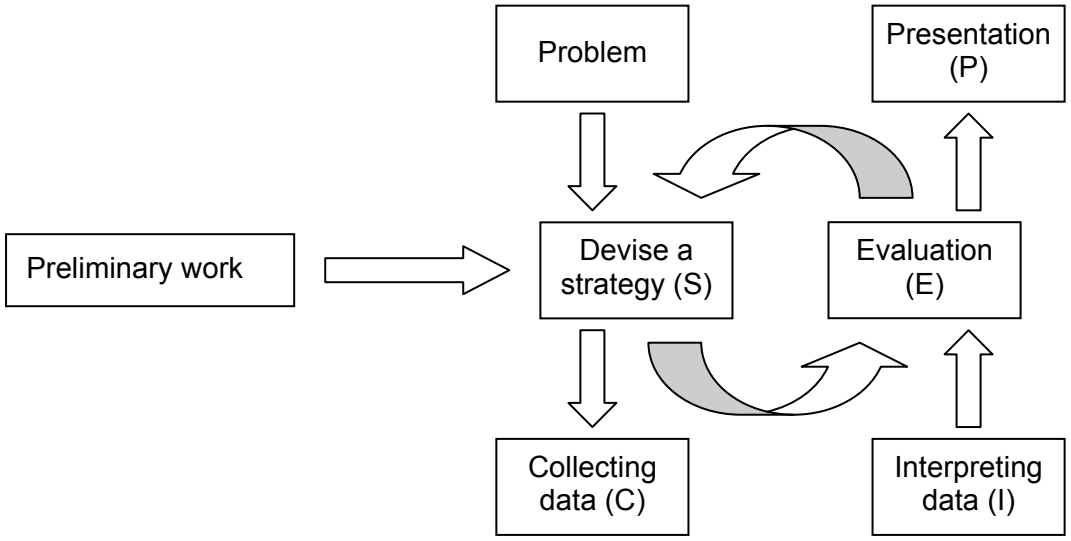
D(a): The majority of reports included headings and/or sub-headings (2 marks) to provide the necessary structure. There was a definite improvement in this aspect and the better candidates included a table of contents and numbered the pages in their report (3 marks) to help guide readers quickly to particular 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.

Practical Investigations

There was continuing evidence this year that Centres were moving away from the previous Sc1 methodology to investigations and a more open ended exploratory approach was being developed. The importance of candidates doing preliminary work to inform the strategy of the main experiment was clearly being recognised and encouraged.

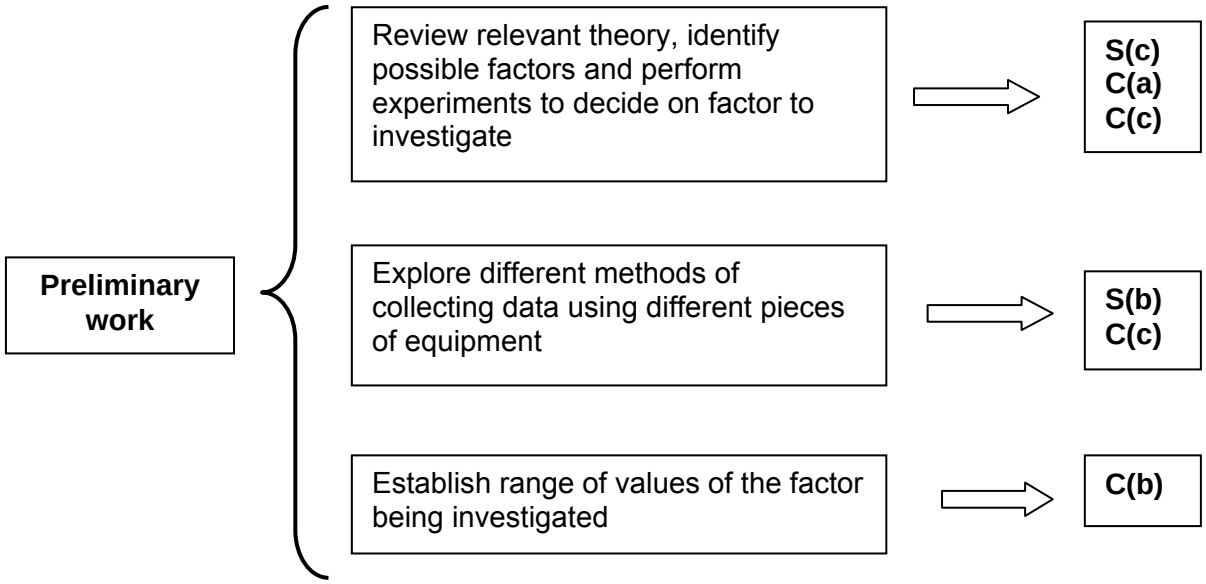


From an assessment point of view the 'performance descriptions' should be used to reflect the quality and performance of candidates' work, rather than a formal/legalistic interpretation of particular words and phrases. There were a number of examples where credit had been incorrectly given for the inclusion 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.

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.

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

The intention is to encourage a more independent approach to investigations and the mark awarded for the aspect, S(c), should reflect the 'value added' by the candidate, beyond the initial teacher stimulus. To justify high marks in S(c) candidates should show independent thinking and the importance of preliminary work cannot be over emphasised in the introductory phase of an investigation; the appropriate amount of time must be given to this aspect.



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).

High marks cannot be supported unless the Centre has provided details of how the task was presented to candidates (eg copies of briefing sheets etc.) or moderators, after inspecting different scripts in the sample, can see that candidates had freedom of choice between different approaches and apparatus. In too many cases moderators noted that candidates had identical ranges and values of the same variables without any further discussion or justification indicating that limited individual decision making had occurred, yet high marks were still being awarded. This necessitated a downward adjustment to the marks for S(c) in a number of Centres. 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 carried out but it was clear that candidates had not really understood why they were doing it.

Many candidates provided a list of appropriate apparatus for their investigations but had not linked it to their preliminary work or indicated why it had been selected in preference to alternative 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 to find the best way to collect good quality data. 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 choose from and this did not allow candidates the flexibility to try various approaches to obtain the best quality data set.

The complexity of a task, S(a), represents an overall judgement about the way a candidate has approached the task. Therefore, two candidates doing the same investigation might approach it differently and therefore achieve different marks. Complexity depends on 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 them during the experiment. Weaker candidates often stated that 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 candidates' access to the higher marks of 7 or 8 in aspects (b) and (c). There was more evidence this year that candidates were doing preliminary work to establish the range of values of the appropriate variable to be used 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 the type of apparatus, equipment and method to choose, to ensure the collection of the most accurate and reliable data [C(c)]. Preliminary work was often simply a shortened version of the main experiment with no attempt to use it to decide on a technique.

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 followed the previous Sc1 approach to investigations and used scientific knowledge to make predictions about the outcome of the investigation at the beginning of the investigation whereas the Twenty First Century Science model 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); 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 this 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.

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).
Attendance at cluster group meetings and OCR INSET meetings both in- and out-of house, using the OCR consultancy service for checking marked scripts, consulting and using the teacher guidance booklets and exemplars on www.ocr.org.uk are all available methods to improve the awareness and understanding of the assessment procedure. It is highly advisable that staff have time during the year for internal standardisation meetings to share and develop expertise in the Science Department.

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

General comments
This paper appears to have been well received by candidates with most attempting all of the questions.

Differentiation was achieved with some questions accessible to all candidates whilst others were more challenging.

Markers had difficulty in reading the answers to some questions where single letter responses were required. A number of candidates used badly written upper and lower case letters, possibly at times intentionally. Letters could be read as C or E, or as B or D.

Many foundation candidates appear to have had difficulty accessing the prose of the written response questions, not fully understanding what is being asked. Hence expressing a clear, lucid answer is difficult for them.

Specific comments on individual questions
Q.1(a) A challenging question with few candidates responding correctly. A and E were correctly identified by many, but D was a popular error.

Q.1(b) The correct response was chosen by the vast majority of candidates.

Q.1(c) Although most candidates responded correctly, D was a popular incorrect response.

Q.1(d) Most candidates responded correctly.

Q.2(a) Generally well answered but ‘inner core’ and ‘outer core’ appeared quite frequently. ‘Molten’ and ‘magma’ also appeared.

Q.2(b) Most candidates responded correctly.

Q.2(c) The majority of candidates answered both parts correctly. Errors commonly made were mostly in the second response where ‘solar system’ appeared quite frequently.

Q.3(a) Many candidates scored two of the three marks here. Most identified A and many gave E but B and D were often chosen instead of C.

Q.3(b) Few correct responses here, the majority choosing A or D.

Q.4(a) Common errors here included ‘absorbs’ and ‘emits’ the wrong way around and ‘refracts’ appearing in random places.

Q.4(b) Although many answered correctly a surprising number gave ‘microwaves’, ‘radio’, ‘gamma’ or ‘alpha’ as responses. There were many different spellings of infrared.

Q.5(a) Most scored at least one mark here although a significant minority did not know what correlation means. Confusion apparent between ‘area of body’ and amount of clothing. Some candidates thought it was a time based graph.

Q.5(b) A good range of responses ranging from good examples of physics correlations that were well explained, to poor physics examples that were well explained, to poor examples that were poorly explained. Marks often lost by a lack of precision in the candidate's response.

Q.6 Generally well answered. The most common mistake was 'infrared' for 'ultraviolet'.

Q.7(a) Most candidates scored 1 or 2 marks here. The first four boxes were the most common responses but few candidates ticked more or less than three.

Q.7(b) Most candidates ticked the correct box. The most common incorrect response was the third box.

Q.8(a) Although the majority of candidates chose correctly a significant minority chose 'physicists' with 'nurses' and 'patients' making an occasional appearance.

Q.8(b) Most candidates scored 1 or 2 marks here. Some responses were not explicit in what was a risk and what was a benefit, and many were very vague e.g. 'he might get better' or 'he might get worse'.

Q.8(c) Most candidates responded correctly.

Q.9(a) Wide range of responses here. A significant number responded with 'infrared' and 'ultraviolet'.

Q.9(b) Many candidates failed to respond correctly. A few error carried forward marks were awarded here.

Q.10(a) Wide spread of marks here with a small number of candidates scoring all three. This was often due to very vague statements unrelated to the information in the table. A number of candidates did not understand the information given. The low efficiency of nuclear power was frequently given as a reason for choosing it.

Q.10(b) Very few candidates obtained this mark.

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

General comments

Generally candidates performed well on this paper. However, there was an increase in the number of candidates who had difficulty accessing the questions and as a consequence performed badly. This suggests that 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, although some very weak candidates left many parts blank. There was no evidence of candidates running out of time.

In general the candidates coped reasonably well with the extended prose questions. However for a significant minority the quality of the handwriting verged on the illegible.

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.

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.

Specific comments on individual questions

Q1a This question was answered well by candidates. B, 'Hydrogen, Helium and Lithium formed in the big bang', was the most common error.

Q1b A & D were the most common incorrect answers. This is probably because the statement that they are looking for disagreement with talks about elements and A & D also mention elements.

Q2a This questions was generally well answered. 'Speed of galaxies and distance from Earth are inversely related' was the most common error, suggesting that the concept of an inverse relationship is not well understood.

Q2b Many weaker candidates incorrectly selected 'Gravity is acting on the galaxies'.

Q2c The most common frequent incorrect answer, 'the universe is orbiting our galaxy', suggests candidates do not understand the term universe.

Q2d 14 hundred billion was the most common error.

Q3a A well answered question. "Fossils" was selected by most candidates. "Rock types" was slightly less frequently selected. The most common reason for a candidate only scoring one mark was to select only "fossils".

Q3b A generally well done question. The most common error was the final answer about sea floor spreading, where candidates have not been familiar with the historical context in which the ideas were accepted.

Q3ci Many candidates lost marks because they tried to show complete plates, drawing horizontal lines connecting to two correct fault boundaries even though the evidence did not warrant this interpretation. The fact that the earthquakes stopped some distance below the boundary of the map may have lead some weaker candidates in this direction. The line of earthquakes across the north of the island was a common distractor. Candidates scoring 1 mark were usually successful at identifying the constructive boundary.

Q3cii Many thought one plate was passing another in a NS direction. Few correct arrows here. Many put more that one arrow showing a poor exam technique

Q4a This question was generally answered well. Common errors were either to incorrectly tick the 2nd box, indicating that microwaves are ionising, or to omit to select the 3rd box. Candidates should by now be aware that the number of marks does not necessarily imply the number of ticks.

Q4b This question was correctly answered by nearly all candidates.

Q5a This question was poorly answered, with very few candidates able to link chemical changes in the atmosphere with the holes in the ozone layer and fewer than half able to state that both involve electromagnetic radiation.

Q5b Respiration was given by the majority of candidates, sometimes incorrectly accompanied by breathing, death or excretion.

Q6 Non causal correlation was not generally well understood and many forgot to explain the meanings of the words.
Lots of correct correlations were given but mostly were causal. A few were able to state a non-causal correlation linked to radiation or global warming. Good examples were 'as global temperatures increase so does inflation', 'as the number of cases of skin cancer increases so do the number of shark attacks'. But many gave 'increased levels of CO_2 are thought to be responsible for increased global temperatures' and 'the longer you spend in the sun, the more likely you are to get skin cancer' both of these were then generally followed by a statement such as 'but other things may have caused this so this is not a causal link'. A small number were able to define 'correlation' usually stating that it was a link between factors. Very few were able to define 'cause' – candidates kept using 'cause' in their definitions

Q7a This question was well answered generally, with all three types of power station being selected. The most common incorrect answers were either answers that were not comparative eg it is 38% efficient rather than the most efficient or answers which were not sensible eg I would chose nuclear as it is the least efficient. A good number based their choices on information that was not in the table – 'it is renewable', which gained no credit. Weaker candidates would often give muddled answers that did not address all three issues.

Q7b The most common correct response was 'it is produced from another energy source'. The most common incorrect responses were insufficient e.g. 'it is man-made' or 'you have to make it',

Q8a Fewer than half of the candidates mentioned 'ionising' and many of those that did linked this to cells e.g. it damages cells by ionising them, it ionises cells, breaks electrons off cells etc. which did not gain the mark.
The second marking point was mostly achieved by mentioning 'mutations'. Only a very small number of able candidates showed a good understanding of this.

Q8b Most candidates got this mark. The most common error was to refer to 'the body' preventing reproduction of cells.

Q8c The most common incorrect answer was doctors closely followed by physicists.

Q9a As always half-life is challenging to many of the candidates, few could do either part. In (i) there were many incorrect responses, with '8' the most common. In part (ii) the most common error was 119 where the candidate halved the nucleon number of uranium-238. It was common to see responses without the "billion" or the "years" showing that the calculation was a mechanical operation without understanding of what the result referred to.

Q9b Weaker candidates often had little idea of what the question was about. Errors included calculating the electrons by adding the previous two numbers or making no attempt to take into account the alpha particle. Candidates who failed to read the question often gave the number of electrons as the same as the number of protons. A common error among more able candidates was to take 2 from both the proton and the nucleon number of the uranium, due to mistaking the number of neutrons for the nucleon number.

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

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

This was the second paper in which one third of the marks were awarded for 'free response' answers in which candidates had to write their own responses as opposed to the more 'objective' type questions of the past. There was definite evidence that candidates were better prepared for this type of question than in the January session

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.

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.

Specific comments on individual questions
1a. The majority of candidates got this correct, but if they did not then they chose protons in (i) and negative in (ii).

1b. In (i) a considerable minority of candidates stated that the rods moved together and touched. In (ii) a large number of candidates had the right idea of the charges repelling, but the language used was poor "negatives detract" or they did not explicitly state that the two rods were repelling and wrote "negative charges do not attract". Others went further and mentioned what happened when positive and positive or positive and negative are brought together. A few candidates went down the magnetism road and wrote north and south poles etc.

1c The most common error in part c was stating that metals also conducted heat well.

2.a.i. Most candidates gained the mark for generator but many incorrectly switched alternating and electromagnetic for their second and third responses.

2a.ii. The answers to this question were very disappointing with less than 20% giving 230 volts. A large number or candidates wrote 240V but the alternatives were wide ranging and bizarre from as low as 0.005 volts to as high as 240 000 000 volts, these answers raising some serious issues about safety.

2a.iii. Most got this correct although "fuse" did have a following amongst a minority.

2a.iv. Most candidates gained 1 mark for "coil of wire", but a significant number wrote "wave" for the core.

2b.i. The majority of candidates had some idea of moving the magnet. Unfortunately a few wrote answers like "cause friction with the magnet" or "rub the magnet" some even suggested attaching the coil to a power source.

2b.ii. Those candidates who achieved only one mark tended to only tick one box, a larger voltmeter was a common error.

3a.i. The placement of the arrow was random, with no consensus of where it should be. A surprising number of candidates drew it coming from the end of the table upwards.

3a.ii. Most candidates got this correct, a few added a few newtons to the force.

3a.iii. This proved more difficult with an unbalanced pair being the most common incorrect answer.

3b.i. Most candidates got friction, although some went down the wrong route and talked about gravity and normal reaction force. Of those who got friction, only about half then went on to say that it would be in the opposite direction to the force.

3b.ii. Candidates gained 0 or 2 on this with very few showed their working.

3b.iii. A surprising number stated what would happen to the velocity using phrases such as “speed up” and did not refer to the momentum.

4.a. Most got this right, those who did not chose to multiply the quantities.

4.b. Very few gained the first two marking points which were concerned with burning fuel to produce a down force and this down force producing an equal and opposite reaction force. Those who gained a mark did so by stating the upward force was greater than gravity/weight. Quite a few candidates unsuccessfully tried to talk about energy transfers. A common misconception was that the rocket went upwards because the ground was pushing against the gases and others referred to gravity being a pushing force.

4.c. Most got this correct, although there were a number who had the wrong number of zeros. It was clear that a number of candidates did not have a calculator in the exam, showing working by hand on the paper.

5.a. Most candidates gained the mark for energy. The most common distractor being particles.

5.b. There was a random selection of lines here! Quite a few candidates thought that they only had to draw two lines and it was common to link longitudinal waves to vacuum and transverse waves to a medium.

5.c.i & ii. There was no pattern in the answers here, candidates who knew (i) did not necessarily know (ii) and vice versa.

5.d.i. Most candidates either restated the question "it's the frequency" or used a random collection of waves words "it's the speed of the wavelength" to try and answer it. A few candidates knew the definition of frequency, but missed the 5 in the 5 Hz.

5.d.ii A surprising number of candidates rearranged the equation and divided the numbers.

6.a. Analogue modulation was the most common distractor.

6.b.i Another random selection of lines. It was surprising that digital was not the most common correct answer given, although there was a considerable mixing up of AM and FM.

6.b.ii. A pleasing number of candidates wrote about interference. Some tried to give examples, ending up by getting in a muddle or talking about disturbances, disruptions and interruptions to sound eg "it's the crackling when you're listening to the radio" being a common response. Many thought it was to do only with sound.

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

General comments

Centres are reminded that this was the first summer session for A332 in the new format, with around a third of the marks from this paper being awarded on open response type questions. Please refer to the OCR website for further details, including specimen assessment materials.

The paper was well attempted and produced a good spread of marks. Candidates seem to have been well prepared for the objective style of questioning. Some candidates seemed significantly less confident when tackling open response questions.

Candidates should be aware that the marking is done from scanned images of their scripts. Consequently, if candidates change their minds, any alterations must be made clearly and unambiguously. Any marks that are ambiguous – possibly made with the intention that the examiner could give credit for either of two possible responses, where only one is correct – will not gain credit on this paper.

The level of difficulty was appropriate for the ability range and most questions were accessible to candidates across the ability range. The majority of candidates generally performed well and marks were awarded across a reasonable range, demonstrating satisfactory differentiation. Scores typically ranged from the low teens to the low thirties (out of 42 marks).

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

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

Specific comments on individual questions

1. Most candidates performed well on all parts of this question on electrostatics, including the free-response section, part (bii). A tiny minority of candidates did not pick up on the point that both rods had been negatively charged in part b, and therefore dropped marks on this section.

2. This question on electricity generation produced good differentiation, with only the most able candidates scoring full marks. In part (a) most candidates picked up on the idea that the magnets were moving, but very few linked this correctly to the idea of producing a changing magnetic field, hence producing a voltage. Weaker candidates described a transformer instead of a generator and a significant number did not attempt the question at all. Average candidates coped with parts (b) and (c) well, most scoring 3 out of the 4 marks available.

3 Most candidates selected the correct formula for kinetic energy in part (ai), but very few converted the mass from g into kg. The majority of candidates recognised that the answer to (aii) should match their answer to (ai). Very few candidates could correctly describe the partner force requested in part (b). Many incorrectly discussed air resistance/friction or gravity as possible answers. Better candidates had no problem with part (c), correctly linking the effect of using an airbag to the end result.

4 Part (a) of this question on rockets caught out even more able candidates. The concept of how burning fuel in a rocket can lead to an upwards force on the rocket inevitably produced lots of common misunderstandings regarding interaction pairs. The most common wrong answer involved fuel from the rocket pushing against the ground, which in turn provides an upward push on the rocket. It should be emphasised to candidates that the partner force in an interaction pair must involve the same two objects ie in this case the rocket and the fuel. The calculation in part (b) was well done, although some candidates got confused with the use of kN and kJ. Only more able candidates successfully tackled part (c), even then some failed to convert the distance into metres before using formula for work done.

5. In part (a) of this question on waves almost all candidates knew that waves can transfer energy, but very few got the second answer correct. Performance was mixed on part (b), with evidence that many candidates could not link the descriptions given to the type of wave associated with them. Part (c) was well answered, although the diagram in part (cii) was open to misinterpretation as being a wavefront diagram (as opposed to the longitudinal wave it was supposed to represent). Because of this 'E' was also accepted as the wavelength to avoid unfairly penalising candidates. Greater clarity in such diagrams will be ensured in future examinations. Candidates who failed to pick up on the opening contextual line produced a generic answer to part (d) ie use a signal generator in (di) and (incorrectly) rearrange wave equation in part (dii). Candidates should be encouraged to read the question carefully before answering.

6. Surprisingly few candidates could recall the correct value for the speed of light in part (ai) of this question. The majority of candidates knew that sound cannot travel through a vacuum, but very few seemed aware that diffraction can occur in both sound and light waves. The final part of this question was answered well by all but the weakest of candidates.

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

General comments
Generally candidates performed well on this paper. Most appeared to be entered for the correct tier, with no candidates gaining very high marks. This was pleasing.

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

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

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

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

There is still evidence of some candidates not having access to electronic calculators in this exam. Candidates should be made aware that they are at a disadvantage in such circumstances.

Specific comments on individual questions
1a This question provided an easy start with most candidates scoring well with either two or three out of three.

1b This was answered well by most candidates. Nearly all candidates gained the mark for knowing CO_2 was the gas, although not as many could suggest an effect of the gas.

1c Part i was answered very well with most candidates being able to identify the volcanic eruptions. The second part, part ii, was more challenging. Candidates could usually identify the variables but less often could describe the correct correlation between the two variables.

1d Most candidates could answer this question well and the range of possible problems caused by climate change was pleasing. A significant minority did write about the ozone hole or global warming, neither of these responses where given credit.

1e This was common to both tiers of this paper, and as such many foundation candidates found it challenging. On part i most candidates scored either one or zero marks, with about a third scoring more highly. Most candidates could write about the problem of destroying the ozone layer or the reduced global warming effect. The best candidates could write a balanced argument showing both the positive and negative effects of this measure. Responses to the second part, part eii, were mostly good and gained credit, although a significant number of candidates did confuse the risk of the UV rays with a risk of breathing in the sulphate particles leading to “gas masks” being a common wrong answer.

2 This question was common to both tiers of paper.

2a About a third of candidates correctly identified the planet as the body that had moved. Incorrect answers included the largest body in the picture. Very few candidates could correctly identify that planets move more or differently than the background of stars.

2b Half of the candidates could explain that the Earth was rotating or the stars were moving across the sky. Common incorrect responses included “the stars are moving too fast”, or that “the stars were moving away from the Earth”. Very few candidates at this level could correctly identify the number of hours.

2c This question was well answered and those candidates who drew a diagram tended to score well on this question. Candidates should be reminded that a diagram can really help in these types of question.

2d Candidates struggled to gain both marks on this question but a pleasing number gained one mark. Some candidates included the length of the respective days, and others mentioned the time taken for the moon to cross the sky.

2e Most candidates struggled to explain the angles and the idea of where they were measured from. Although about a quarter of candidates did understand the idea of the angle, very few could explain where it was to be measured from.

2f Just over half of the candidates gained the mark for part i, with D being a popular wrong answer. For part ii most candidates gained at least one mark, with typical wrong answers including the ideas that it is easier to manipulate or improve the digital image using a computer.

3 This question was answered very well with the majority of candidates scoring two or three marks. Again it should be pointed out to candidates that in this case diagrams helped a great deal to explain the order of the bodies and the direction the light was travelling in.

4 a This question was answered very well by the majority of the candidates and some very pleasing scores were recorded. Again it is worth pointing out that candidates without an electronic calculator find this type of question very much harder than they would otherwise. In part iii almost all candidates scored one mark, with only a few gaining the second mark. Candidates are reminded to read the stem of the question carefully to ensure they know how many options should be ticked.

4b Surprisingly a third of candidates did not know the minimum number of lenses required to make a telescope.

4c Candidates did well on this question with a significant minority just repeating from the stem of the question with the answer “reflectors”. This did not gain credit.

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 a significant increase in candidates at the lower end of the ability range. 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.

Candidates are finding greater difficulty with the quality of their writing. Deciphering their answers is becoming more difficult. This will become more of an issue as more extended response questions are introduced to the exam.

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. Careless mistakes - like rounding down in Q5bii to 10.5 were common. Candidates appeared to use the available time well.

Specific comments on individual questions
Q1ai Candidates proved adept at identifying the risk but often opted for 'cooling the planet' as a benefit and did not appreciate how severe the situation would have to be before attempting this solution.

Q1aii Candidates fell into two broad groups; those who appreciated the risk was UV and so answered the question as expected and those who mistakenly identified the sulphate particles as the risk – even if the risk was correctly identified in part i. This second group often went down the route of face/gas masks or living at a different altitude.

Q1bi The majority of candidates correctly identified the eruptions as the evidence although few appreciated that the reason the evidence was unconvincing was because it was limited. Many more candidates opted to explore 'other factors' looking at the nature of the evidence rather than the quantity. The quality of written communication mark was gained by most candidates.

Q1bii The most able candidates were able to link the reflection of light with a reduction of heat into the Earth. However, most only saw one or other of these explanations. It was pleasing to see that most candidates understood that the concept of reflection was needed, whether of light or heat. A few candidates mistakenly identified the reflection of heat already within the Earth.

Q1biii Only the most able candidates were able to answer this question correctly. Many simply repeated or paraphrased their answer to 1bii rather than having an appreciation that the scientific knowledge provided a mechanism. Some candidates moved beyond their answer to bii but stopped short of a full answer, simply saying this provided 'proof' or 'a theory'.

Q1c It is clear that many candidates are still confused between the greenhouse effect and holes in the ozone layer. Those candidates who wrote succinct answers were more likely to score all 4 marks than those who rambled and added extraneous, incorrect information. Some candidates misunderstood the need to list the gases involved and spent time listing all of the gases they knew to be in the atmosphere before stating which they thought relevant to the question. Candidates gained the greenhouse effect marks more readily than the ozone ones. Most were able to identify greenhouse gases (although many included incorrect ones and lost credit) and

linked to global warming. Very few candidates were able to explicitly separate the idea of ozone as a gas from the ozone layer or to link the ozone holes to increased amounts of ultraviolet, instead citing it as the reason for global warming.

Q2ai Many correct answers. The most common error was the largest dot towards the top.

Q2aii Many candidates did not appreciate that an idea of motion relative to 'fixed' stars was needed for the mark. Some simply referred to planets orbiting the Sun or moving across the sky whilst others seemed confused by the historical context.

Q2bi Well done by the majority of candidates with better candidates often writing detailed explanations. Candidates seemed familiar with this photograph.

Q2bii Fewer than expected realised this was ¼ of a day. 3 was the most common incorrect answer so perhaps candidates were thinking of ¼ of a 12 hour dark period.

Q2c Better candidates drew simple but accurate diagrams and gained both marks. Weaker candidates knew that they needed to refer to the Earth's orbit but were unable to link this with looking at a different part of the sky or vice versa. The weakest candidates referred to the rotation of the Earth or the direction a telescope is pointed in.

Q2d Candidates had obviously been taught this topic. However, many were unable to express themselves clearly or had not grasped the topic well enough to score full credit. Many referred to the orbital path but then only mentioned the difference in length of the 'day' rather than how it comes about. Weaker candidates referred to the need to 'move' more without giving an indication of how or why.

Q2e Candidates had clearly learned alternative names for co-ordinate systems rather than an appreciation that these are based on angles. Some candidates were able to express an idea of 'up and across' and so scored partial credit. The weakest candidates often referred to distance away and time or simply expressed an idea of where to point a telescope.

Q2fi This was answered correctly by most candidates. The most common errors were A and E, suggesting that even the weaker candidates knew the light was brought to a focus.

Q2fii Candidates knew what was expected of them in this question and so the majority were able to gain full credit. Weaker candidates referred to 'human error' or repeated an idea of precision. Better candidates were able to write articulately about benefits and gave relevant examples to confirm their understanding.

Q3a The most common incorrect answer was A.

Q3bi Most candidates forgot to include a unit even when they had correctly calculated 0.05. Those who used cm were more likely to include the unit and score 2 marks.

Q3bii The most common error was Y (which was often associated with W in part biii) suggesting confusion over lens diameter and power.

Q3biii Many candidates seemed confused by power and diameter. Better candidates referred to light collection although some went on to spend time writing about diffraction effects.

Q3c Answers here were often too vague to be creditworthy, such as 'mirror' or 'parabolic/curved mirror', or simply wrong e.g. 'concave lens'.

Q4ai This question was usually answered well, but many lost marks by referring to 'brightness' rather than 'luminosity' as given on the graph.

Q4aii Some candidates only gave the change in wavelength rather than linking this to a correct change in temperature. The most able candidates were able to gain credit by understanding the direction of the relationship.

Q4aii In general candidates did poorly with this calculation. The most common error was −273 not +273, although others seen were multiplying or plucking a number at random e.g. 10 000.

Q4b This was generally well done, A common error was to give the elements a name, which was not possible.

Q5a Many candidates gained two out of three marks but a few included all three marking points. Some candidates switched between macroscopic and microscopic explanations and these often failed to achieve full credit as the same marking point was written twice. Weaker candidates did not appreciate what the question was asking and went into an explanation of fusion and did not gain any marks.

Q5b This was well done by most candidates. Common errors were fission, supernova and combustion.

Q6ai Most candidates who attempted and wrote out a calculation scored full credit with only a few answers outside tolerance (gaining 1 mark). Weaker candidates did not appreciate the need, or know how, to find the gradient and multiplied the numbers, scoring 0.

Q6aii Units were often omitted here even on correct calculations.

Q6bi Few candidates were able to score full credit on this question. A common error was the assumption that ‘pulsing’ implied a change in luminosity. Candidates need to be taught to be explicit in their descriptions and not to assume that correct science will be read into incomplete answers. Most candidates had the idea of a link between period and luminosity and this was the most commonly awarded marking point for this question. The majority of candidates finished their explanations at this point rather than including what was necessary for the final marking point.

Q6bii Most candidates had an idea of parallax but many went on to paraphrase their answer to bi (sometimes writing the answer expected for bi here) rather than appreciating that what was needed was a precursor to the Cepheid method.

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