Course Report 2016

Subject	Physics
Level	National 5

The statistics used in this report have been compiled before the completion of any Post Results Services.

This report provides information on the performance of candidates which it is hoped will be useful to teachers, lecturers and assessors in their preparation of candidates for future assessment. It is intended to be constructive and informative and to promote better understanding. It would be helpful to read this report in conjunction with the published assessment documents and marking instructions.

Section 1: Comments on the Assessment

Component 1: Question paper

The National 5 question paper consists of Section 1, which is an objective test worth 20 marks, and Section 2, which contains restricted and extended response questions worth 90 marks. Section 2 is scaled to 60 marks.

The majority of marks available are awarded for applying knowledge and understanding. The remaining marks are awarded for applying scientific enquiry, scientific analytical thinking and problem solving skills. A variety of question types are used in the question paper, including:

- extended questions based on an application of course content
- extended questions based on practical/experimental work
- extended questions based on content not specified within the course, assessing skills
- extended questions based on content within the course, assessing skills
- open-ended questions
- extended questions assessing scientific literacy
- extended questions based upon course content
- multiple-choice questions

This component of the course performed as expected and presented candidates with the opportunity to demonstrate knowledge and understanding, as well as a range of skills.

The general impression of markers was that the question paper had an appropriate number of questions accessible to ‘C’ grade candidates. Markers also reported that the paper included appropriate questions to provide good discrimination for candidates performing at ‘A’ and ‘B’ levels.

Analysis of the question paper results showed that all questions were answered correctly by at least a proportion of the candidates, and that there was a spread of performances across the range of available marks.

Some markers indicated that some answers they observed may suggest that some candidates had not prepared for the assessment or had been presented at the wrong level. However, following the pattern from last year, the number of instances of this appears to be continuing to decrease.

Component 2: Assignment

In the National 5 Assignment, candidates have to investigate a relevant topic in physics and communicate the findings of their research in a report. This topic must have a relevant application and an effect on the environment and/or society.

The assignment assesses the application of skills of scientific enquiry and related knowledge and understanding of physics.

Markers commented that candidates had the opportunity to achieve marks for all of the skills and knowledge and understanding being tested. In addition, many markers commented that there was opportunity for candidates to achieve high scores.

Markers commented that the majority of candidates appear to be following the advice available to them in the 'Physics Assignment Assessment task — Appendix 1: Instructions for Candidates', which details advice and guidance for the various stages of the assignment, and the marks available for each aspect of the report. However, there were still a few instances of candidates who appeared to have a poor understanding of the requirements of the task.

Markers commented favourably on the amendments made to the Marking Instructions, compared to previous years, and indicated that these had allowed more candidates to access more of the marks available.

It was noted that candidates who had chosen an appropriate experiment/practical activity as one of their sources of data tended to perform well in the assignment.

Section 2: Comments on candidate performance

Areas in which candidates performed well

Component 1: Question paper

Section 1: Objective test

This section of the question paper seems to have been reasonably straightforward for most candidates. A majority of candidates answered at least 13 questions correctly.

Questions 1, 2, 3, 9, 13, 14, 15 and 18 were answered particularly well.

Section 2: Extended answers

Many candidates were successful with questions requiring the selection of a relationship followed by a calculation and final answer. In particular, two of the questions requiring candidates to show how they arrived at the final answer by including an appropriate relationship and appropriate substitutions in their response — Questions 3(a) and 4(c)(i) — were generally performed well.

Candidates who successfully answered questions that required justifications, descriptions or explanations were able to structure their answers to present information which was clear and relevant to the question being asked. They used correct terminology and references to appropriate physics concepts (eg Newton's Laws of Motion).

- Question 1(a): Most candidates were able to correctly calculate the average current in a lightning strike using the information provided about charge and time.
- Question 2(a): The vast majority of candidates were able to show how a voltmeter should be connected to measure the voltage across the specified component.
- Question 3(a): The majority of candidates were able to show how the energy required to heat a material is calculated, using the information provided about the mass of the

material and its temperature change, by including the appropriate relationship and the correct value for the specific heat capacity of the material in their response.

- Question 3(b): Most candidates were able to use the value of energy required to heat a material, as well as the specified power rating, to calculate the time taken for this energy to be supplied.
- Question 4(b): The majority of candidates correctly identified gamma radiation as having a shorter wavelength than X-rays.
- Question 4(c)(i): Most candidates were able to correctly show how the wavelength of an electromagnetic wave is calculated from its frequency by including the appropriate relationship, unit prefix conversion and value for the speed of light in their response.
- Question 6(b)(i) and (ii): The majority of candidates were able to determine the angles specified using the information provided in the graph.
- Question 6(c): Most candidates were able to suggest a reason why it is good practice to repeat measurements during an investigation.
- Question 7(a): The calculation of the activity of a radioactive source, given the number of decays and time taken, was performed well by most candidates.
- Question 8(a)(i): The calculation of the absorbed dose, given the energy absorbed and mass of tissue, was also well performed by most candidates.
- Question 8(b): Most candidates were able to use the information provided about the initial activity of a radioactive source and its half-life to determine its activity after a specified time period.
- Question 10(a): The majority of candidates were able to extract the required information from the velocity-time graph in order to correctly calculate the acceleration of the falling climber.
- Question 12(a): The calculation of the weight of the spacecraft on Earth, given its total mass, was well performed by most candidates.
- Question 12(c)(i): Most candidates were able to correctly determine the total force produced by the thrusters on the spacecraft, given in information provided.

Component 2: Assignment

Section 1: Statement of Aim

The vast majority of candidates were able to devise an appropriate aim for their investigation.

Section 2: Describe an application of physics and explain its effect on the environment/society

Most candidates were able to access the second mark for explaining a clear relationship between the application and its effect on the environment/society.

Section 3: Select relevant sources

Many candidates started by stating that a source was relevant or reliable followed by a reasoned explanation, clearly indicating why it was relevant or reliable. The fact that candidates are no longer required to use the terms *relevant* or *reliable* allowed more candidates to access more marks for this section.

Section 4: Select relevant data/information from sources

Most candidates selected data that was relevant to the aim of the report. These candidates included the relevant raw data in their report and made clear statements about the sources of this data.

Section 5: Process and present data/information

(a) Processing of data/information: Some candidates provided two acceptable examples of accurately processed raw data from at least two sources.

(b) Presentation of data/information: Most candidates chose appropriate formats to present the selected data/information from at least two of their sources. Amendments to the Marking Instructions, in terms of allowing candidates to present two of their data sources in the same format, allowed more candidates to access all the marks for this section.

(c) Complete labelling of graphs, tables, charts or diagrams: Many candidates successfully achieved this mark because of the consistent, correct labelling of their presentation formats.

(d) Comparison of data/information from at least two sources: Some candidates successfully accessed this mark by comparing data from two sources in their report, or by making a clear statement that the two sources of data could not be compared.

Section 6: Drawing a valid conclusion

Successful candidates related their conclusion to their stated aim and also provided sufficient relevant data to support their conclusion within the report.

Section 7: Apply knowledge and understanding of Physics

Some candidates were able to access full marks for a clear explanation, which demonstrated a good understanding of the physics involved. Many candidates were able to access the majority of marks by offering an explanation which demonstrated a reasonable understanding of the physics involved and included appropriate physics terminology and concepts.

Section 8: Structure of the report

The majority of candidates were able to achieve most of the marks available for this section. Most candidates provided an appropriate and informative title related to their report and, in general, candidates provided sufficiently detailed references to the sources, which would allow them to be retrieved by a third party. The vast majority of reports were sufficiently clear and concise.

Areas which candidates found demanding

Component 1: question paper

Section 1: Objective test

Questions 5, 7, 10 and 19 were answered incorrectly by a majority of candidates.

- Question 5: A significant number of candidates failed to identify that the minimum pressure would be exerted when the block is placed with its largest surface area in contact with the table top. Many candidates simply calculated the pressure exerted by the block in the orientation shown in the diagram.
- Question 7: Many candidates appeared to confuse the relationship between kelvin and degrees celsius and how the relationship between the pressure of a fixed mass of gas at constant volume and its temperature in these units is displayed graphically.
- Question 10: This question required candidates to extract and process a number of pieces of information, given in both text and diagrammatic form, to determine the speed and frequency of a wave. While most candidates were able to identify one or other of the two quantities required, only some candidates were able to identify both simultaneously.
- Question 19: Many candidates did not appear to identify this as a question involving the relationship between heat energy, latent heat of vaporisation and mass; either by making incorrect use of the relationship between heat energy, specific heat capacity,

mass and temperature change (even through there wasn't one); or by selecting a value for latent heat of vaporisation from the wrong table on the Data Sheet.

Section 2: Extended answers

In general, questions requiring justifications, descriptions or explanations were more demanding for candidates. There was often a lack of precision in candidates' responses, especially when using physics terminology and principles.

- Question 1(b): This question required candidates to apply numeracy skills to solve a problem. Many candidates did not recognise that the question simply required them to divide the total charge by the charge on an electron.
- Question 1(c): Although many candidates recognised that the strip of metal was an electrical conductor, few were able to relate this to the idea that an electrical current (or charge, or electrons) could then pass through it. Many candidates expressed ideas such as the lightning passing through the strip of metal, which does not explain the situation using appropriate physics terminology.
- Question 2(b): Although many candidates identified that the variable resistor played a role in obtaining a range of values of voltage and current in the circuit, only some identified that it was the resistance of the variable resistor that needed to be changed.
- Question 2(c): Some candidates averaged or totalled the voltages and currents before applying the Ohm's Law relationship to their values. This is incorrect physics and prevented access to any marks other than that for the relationship.
- Question 2(d): Many candidates failed to state a conclusion about the resistance of the filament lamp, but instead described the relationship between the voltage and current.
- Question 3(b)(ii): Many candidates did not make it clear either that it was heat (rather than just energy) that was being lost, or where it was going to (eg the surroundings).
- Question 3(c): Although this was intended to be a more challenging question, testing the A grade criteria, it was disappointing to see that few candidates were able to describe how the circuit switched off the heating element, despite the emboldened text in the question. Instead, some candidates chose to describe how the transistor and relay were switched on.
- Question 4(a): Few candidates were able to state a detector of infrared radiation. Instead, many stated a device that would contain a detector (eg an infrared camera, or night vision goggles).
- Question 5: Although many candidates made correct statements about the similarities and/or differences between the waves, few were able to develop their answer fully to demonstrate a good understanding (eg to fully explain what is meant by the terms *diffraction* or *transverse*, or to state correct values of the speeds of the waves in appropriate materials).
- Question 7(b): This question, again, required candidates to apply numeracy skills to solve a problem. Many candidates did not recognise that the question could be solved by multiplying the activity of the source (the number of decays each second) by the energy produced by each decay. Some candidates attempted to solve this using the relationship between power, energy and time, but many of these made errors at the substitution stage of their working.
- Question 9(a)(i): Of those that attempted the question using Pythagoras' Theorem many did not recognise that the North and South displacements could be resolved

into a single displacement in the North direction, before applying the theorem. (There were even examples of the theorem being applied to a ‘four-sided triangle’, eg $a^2 = b^2 + c^2 + d^2$.)

- Question 9(a)(ii): As in the previous part of the question, many candidates failed to resolve the North and South displacements before determining the direction using trigonometry. Also, many candidates, who did manage to calculate an angle correctly, were unable to express this appropriately as a direction, using either a three-figure bearing or relating the angle to compass points (eg 62° East of North).
- Question 9(b)(i): Many candidates neglected to include a direction, as well as a magnitude, in their statement of the average velocity of the student.
- Question 9(b)(ii): Although some candidates identified that the distance between point X and point Y was greater than the magnitude of the displacement between the points, few appeared to recognise that the difference between the average speed and the magnitude of the average velocity also related to the time being the same.
- Question 10(b): Although many candidates identified that the question could be solved by determining the area under the graph, there were many instances of incorrect values being extracted from the graph at the substitution stage of their working.
- Question 10(c): Many candidates did not recognise that the rope would exert a force on the climber. A description such as ‘force of rope’ (or ‘tension’), along with an upward arrow, would have been sufficient to achieve the partial mark allocated for this force. In addition, candidates who were imprecise in their description of the forces acting on the climber (eg 'gravity' alone, rather than 'weight' or 'force of gravity') did not achieve all the marks available.
- Question 11: Many candidates identified a possible factor in the variation of ground roll, but few went on to develop their answer to explain how this factor affected the ground roll using appropriate physics terminology and principles (eg by relating the situation to the forces involved and Newton’s Second Law of Motion). There were also many candidates who appeared to confuse the horizontal and vertical forces acting on the aircraft (eg by making comparisons between the engine force and weight of the aircraft).
- Question 12(b)(i): Many candidates were unable to correctly state the energy change in a photovoltaic cell.
- Question 12(b)(iii): Although most candidates selected the correct relationship to solve this question, many did not make the correct substitution for the power output of the solar cells.
- Question 12(c)(ii): Again, most candidates selected the correct relationship to solve this question, but many did not make the correct substitution for the mass of the spacecraft. In this question, the mark allocation should have indicated that there was an extra stage involved, over and above a standard three-mark calculation.
- Question 13(a): Many candidates failed to use the term *nuclei* in their description of nuclear fusion.
- Question 13(c): This is a 'show' type question, and many candidates did not show all the required stages of the calculation to attract all the marks. These stages include starting with a correct formula, showing the correct substitutions, and ending with the correct final value, including the unit. In particular, many candidates failed to make reference to the formula relating distance, speed and time in their response, and were therefore unable to access any more marks than that allocated to a statement of the value of the speed of light. A few candidates appeared to have memorised the

value of a light-year in metres, but, in this question, this was insufficient to show how the distance is derived.

- Question 13(d): Many candidates did not make it sufficiently clear that light from the supernova would take time to reach us.

Component 2: Assignment

Section 1: Statement of Aim

Although the vast majority of candidates gained the mark for providing a suitable aim for their assignment, a significant number of them overcomplicated their aim by adding multiple aspects to it, such as ‘The effectiveness of seatbelts and the physics behind them’ or ‘The power output of solar cells in different conditions and their impact on society’. Often, in these cases, not all of the aims were investigated or referred to in the conclusion. This led to a difficulty in accessing the conclusion mark later in the report.

The choice of some topic areas (eg semiconductor devices) made accessing marks in the underlying physics section, in terms of applying knowledge and understanding at a suitable level, more difficult for some candidates later in the report. Also, a few candidates identified aims that had little to do with physics at National 5 level (eg ‘The effect of sunlight on skin cancer rates.’ or ‘The number of nuclear weapons held by different countries.’).

Section 2: Describe an application of Physics and state its effect on the environment/society

Many candidates did not gain the first available mark because they did not provide an appropriate application and use a physics explanation to describe its characteristics and/or features. (For example, to state that 'a seatbelt provides a restraining force during a car crash'; 'solar cells convert light into electrical energy'; ‘crumple zones reduce the force acting on passenger during a car crash by increasing the time of impact’; ‘nuclear power stations convert nuclear energy into electrical energy’; ‘LEDs convert electrical energy into light’; or ‘X-rays are high energy electromagnetic waves that are absorbed by different amounts depending on the density of the material through which they are passing.’)

Section 3: Select relevant sources

Some candidates did not provide a sufficient explanation for the choice of sources. For example, some stated ‘my source was relevant to my aim’ or ‘my source was reliable’ with no/insufficient explanation or evidence of why it was relevant or reliable.

For sources of data that came from practical activities, explanations such as ‘it is reliable, because I did it myself’ were insufficient, unless they went on to explain how they repeated their measurements (and there was some evidence that they did so), or took control of other variables that may have affected their results.

Section 4: Select relevant data/information for inclusion in the report

Some candidates selected data that was not relevant to the aim of the report (for example, data on numbers of car accidents without any reference to seatbelt use.)

The relevant raw data must be included in the report and be clearly identifiable to allow subsequent access to marks in section 5. A few candidates did not make it clear what was relevant data or the sources of this data.

Some candidates selected sources of data that were hard to process (eg graphs without sufficiently detailed scales on axes or 3D bar charts, where it was hard to ascertain values for the heights of the bars).

Section 5: Process and present data/information

(a) Processing of data/information: Many candidates did not present the information accurately enough to attract the relevant marks.

Some graphs were poorly drawn, with inaccurate scales and inaccurate points (particularly where they were not drawn on graph paper). Some candidates were also unable to draw appropriate lines or curves for their graphs.

When using software packages to produce graphs or charts, some candidates failed to alter some of the parameters from their default values and, as a result, made it very difficult for them to be checked for accuracy (eg the lack of inclusion of minor gridlines and excessively large data point markers).

When attempting to process data provided in graphs or charts into tabular form, some candidates stated unreasonably accurate values in their data given the raw data provided.

When candidates had produced pie charts, it was often the case that the data had not been processed correctly. This meant that the proportions of the sections of the pie chart were incorrect. The use of 3D pie charts as a presentation format by a few candidates made it very hard for markers to ascertain their accuracy.

When candidates processed data by calculation there were a number of instances of the incorrect use of significant figures and/or inaccurate rounding.

Where candidates attempted to process information in the form of a summary, there was often insufficient detail to convey an accurate picture of the information and instead candidates just stated a simple generalisation or conclusion. On the other hand, there were a few instances where the summary was, in fact, more expansive than the original data and therefore was not really a summary at all.

(b) Presentation of data/information: Some candidates produced an inappropriate presentation format (eg a pie chart for a continuous variable).

Some candidates who processed their data by calculation, failed to present a sample calculation organised in a logical and coherent manner.

(c) Complete labelling of graphs, tables, charts or diagrams: Some candidates did not achieve this mark because they did not label the relevant presentations completely.

(d) Comparison of data/information from at least two sources: Some candidates did not make any statement regarding a comparison of their data/information from two sources. This was often due to the fact that they had chosen two (or more) disparate sources that did not allow comparison, although a statement from the candidate to this effect would have been awarded marks.

Some candidates did not make it clear what it was about their data/information from the different sources that was comparable, but simply stated an overall conclusion from the combined data/information that was not justified for either piece of data/information taken individually.

There were also some candidates who made inaccurate statements about the comparison of their data (eg stating 'both my sources show that...' when, in fact, the data provided was not comparable.)

Section 6: Drawing a valid conclusion

Some candidates did not relate their conclusion to their stated aim. This was particularly the case when candidates had stated multiple aims earlier in their report but had not offered conclusions to all of these aims in this section.

In addition, there were cases where the data that candidates had provided elsewhere in the report did not support the conclusion.

Section 7: Apply knowledge and understanding of physics

Many candidates achieved one mark for demonstrating a limited understanding of the physics involved. Some candidates did not achieve marks for this section because they offered little or no relevant physics explanations and/or did not relate these to the application being discussed.

When candidates had selected topics for which the underlying physics was at a level above National 5, it was often hard for them to demonstrate either reasonable or good understanding of the physics involved (see previous comments for Section 1).

Section 8: Structure of the report

A few candidates did not give an appropriate and informative title that related to the report content. The title ‘National 5 Assignment’ is not an appropriate or informative title.

Some candidates did not give sufficiently detailed references to the sources that would allow them to be retrieved by a third party. Insufficiently detailed website addresses, such as ‘www.bbc.co.uk/education’, were occasionally provided. When candidates had provided text references, these were often incomplete (eg lacking an edition number or a page number). When candidates had elected to process experimental data in their report, they often omitted to provide either a title or aim for the experiment as a reference.

Section 3: Advice for the preparation of future candidates

Component 1: question paper

Each year, the question paper samples the content of each unit of the course in approximately equal proportions. This means that candidates should be familiar with all aspects of the course.

Candidates sometimes did not give any answer to particular questions, which could suggest lack of familiarity with the course content to which the questions referred. The question paper tests the application of knowledge and understanding, and the application of the skills of scientific enquiry, scientific analytical thinking and problem solving skills. Candidates should have the opportunity to practise these skills regularly to familiarise themselves with the type and standard of questions which may be asked.

Section 1 is worth 20% of the marks available for the course assessment. At this level, candidates may spend too much time completing Section 1 of the question paper, which then reduces the time left for completing Section 2, which is worth 60% of the marks. Candidates should practise objective test items for Section 1 and extended questions for Section 2 to ensure that they can complete them in a time proportionate to their mark allocation in the question paper.

Questions that require justifications, descriptions or explanations always feature in the assessment but are often answered poorly. These types of questions are frequently based on practical coursework and data obtained from experiments. Candidates should, where possible, have the opportunity to experience exposure to key practical work which may help to improve understanding of concepts, procedures and apparatus. Frequent exposure to the use of physics terms and ‘language’ may help candidates develop their communication skills when answering such questions.

Candidates should be made familiar with the various 'command words' used in physics questions, and how to respond to them. For example, when candidates are asked to 'show' that a particular answer is correct, they should start their response with an appropriate formula, show the correct substitutions and end with a final answer, including the correct unit, to obtain all the marks available. In a 'must justify' question, they must not only state or select the correct response, but also provide supporting justification to attract any marks.

For questions requiring calculations, the final answer sometimes had the wrong or missing unit. Centres should remind candidates that a final answer usually requires both a value and a unit. Candidates should also be familiar with the full range of units used for quantities covered in the National 5 course.

In calculations, some candidates were unable to provide a final answer with the appropriate number of significant figures (or to round these correctly). It was evident that some candidates confuse significant figures with decimal places. Centres should ensure that candidates understand and can apply the rules concerning significant figures.

Candidates should be given the opportunity to practise open-ended questions at appropriate points during the course. They should be encouraged to not only state relevant physics concepts but also to relate them to the situation described in the question. Having attempted such questions, it may be beneficial for them to have sight of a range of responses and to discuss how marks would be awarded for these responses. Such responses can be generated by their peers, or are available from sources such as the SQA Understanding Standards website.

The published Marking Instructions contain general marking principles, and also detailed marking instructions for specific questions. Candidates should be encouraged to become

familiar with the allocation of marks and the importance of complete final answers when answering numerical questions. Candidates should have access to specific Marking Instructions when practising exam-type questions. The Marking Instructions published on SQA's website illustrate how marks are apportioned to responses.

Component 2: Assignment

There were a few examples of reports that were little more than essays discussing a particular topic rather than a researched and reasoned scientific report. Such reports did not demonstrate application of the skills of scientific enquiry and related physics knowledge and understanding — which is what the assignment assesses. Candidates should be encouraged to produce a suitable scientific report and advised not to produce essays for their assignment report.

It is important for candidates to receive the appropriate guidance when undertaking the assignment. The 'Physics Assignment General Assessment information' document advises assessors to give reasonable assistance during the research stage which might include:

- directing candidates to the 'Instructions for Candidates'
- clarifying instructions/requirements for the task
- advising candidates on the choice of topic or issue

Also, at the communication stage of the assignment, assessors may continue:

- directing candidates to the 'Instructions for Candidates'
- clarifying instructions/requirements for the task

Centres are advised to give a copy of the 'Instructions for Candidates' which appears in Appendix 1 of the publication 'Coursework assessment task for National 5 Physics' to their candidates.

Centres should also share the Marking Instructions with candidates, so that they understand how marks are awarded. However, these should not be available to candidates when they are actually writing their report.

Centres should not provide a pro-forma that directs candidates to complete specific sections of the report or over-direct candidates during the completion of their report.

Presentation of the report

Many successful candidates presented their report in the order of appearance of each section. This meant that interpretation of the report was sequential and easy to follow. Many candidates placed helpful headings before each section of the report to help identify each section.

A few candidates did not gain marks because the structure of their report was not in any sequence. This meant that some of the sections were difficult to identify. Candidates should be encouraged to follow the structure outlined in the Candidates' Guide.

When candidates use word processing packages to produce reports, they should take care to clearly identify those parts of the report that contain raw data from their sources and those that they have produced themselves.

Choosing the topic for research

Centres can offer advice to candidates on the choice of topic or issue for research. Generally, appropriate topics:

- related to content of one or more of the course units
- were at a level of understanding consistent with National 5
- included sources of data and data itself which were understandable at National 5 level and could be processed by the candidate

Less appropriate topics:

- had limited or no published data, making it difficult to achieve marks for later sections of the report
- required an understanding of physics at a level greater than National 5, causing some marks, for example the underlying physics, to be inaccessible

Centres should encourage candidates to choose topics that lend themselves to the type(s) of data processing and presenting that is assessed in the assignment, and advise against researching topics for which little or no data can be accessed. Centres should also consider taking an approach where candidates can include and compare their own experimental data with literature research, rather than simply pure literature research.

Statement of Aim

Successful statements of the aim related to relevant research data within the report and to the conclusion. Some candidates stated an aim which did not relate to the data or to the conclusion. Statements of multiple aims should be avoided.

Description of an application of physics and its effect on the environment/society

Successful candidates achieved both marks by:

- Describing an application for their research, and providing an explanation of its characteristics and/or its features. This explanation could include a brief discussion of the physics involved to describe how the application works or is achieved.
- Making a clear statement of the relationship between the chosen application and its effect on the environment or society. The stated relationship can be positive or negative, depending on the application.

Centres should advise candidates on the suitable choice of topics to allow these marks to be accessed.

Select relevant sources

Successful candidates explained their choice of sources by:

- Stating whether the source was relevant, followed by their explanation of why this was the case, which included some detail of what information was contained in the source.
- Stating whether the source was reliable, followed by their explanation of why this was the case.

Successful candidates also chose to accompany the source selection explanation with identification of the source of the information. (Many candidates included full URLs or text book references at this stage).

Centres should encourage candidates to follow the guidance above, which is also contained in the Candidates' Guide, and ensure that candidates understand what makes a source relevant and/or reliable.

Select relevant information from sources

Successful candidates selected and included relevant data/information from at least two different sources clearly, and indicated which source the data/information had come from.

It should be emphasised to candidates that this data/information should come from two different sources, and that two pieces of data/information from the same source (eg the same web domain or same text book) will not be awarded all the marks available.

The data/information selected from each source should be unprocessed by the candidate and clearly identified as source data. The source data/information should be 'raw' data. Candidates often clearly demonstrated this by attaching printed copies of the raw data/information to their report rather than transcribing it.

When selecting data from an experimental source, candidates should ensure that they include their actual measurements, so that the accuracy of their processing can be determined at a later stage.

Candidates who did not present any raw data/information at this stage were not able to access marks for the next processing stage because the accuracy of their processing could not be verified.

Centres should remind candidates that they must include the raw data/information from their sources in the report.

Processing information

Successful candidates were able to process the information accurately in the chosen presentation format by:

- Using graph paper to draw graphs, and ensuring that appropriate scales were used and that data points were plotted accurately, and correctly selecting whether to connect points on graphs in dot-to-dot fashion or attempting to draw a best fit line or curve.
- Ensuring that, when using Excel or other software packages to draw graphs, the appropriate type of graph was selected, as well as making sure that the accuracy of

the data points could be ascertained by markers (eg by using small data point markers and including minor gridlines).

- Ensuring that at least one sample calculation was shown, together with the correct units when processing data by calculations and that an appropriate number of significant figures were used and rounding these figures correctly.
- Making sure that any summaries provided 'painted a picture' of the data rather than being a simple generalisation or conclusion. Accurate summaries also included correct units for any quantities stated.
- Making sure that values extracted from graphs or charts were realistically accurate given the raw data provided.

Candidates should be made aware that the standards applied for the accuracy of processing information in the assignment are the same as they are for the question paper.

In the assignment a minimum of 90% of the processed items (eg averages, calculated values and points) for each presentation format must be correct for the mark to be awarded.

Note that candidates who did not include relevant data/information in the previous stage would not be able to access these processing marks.

Presenting information

Successful candidates chose at least two appropriate formats to present the processed data. An indication or heading was useful in identifying each presentation format.

Centres should ensure that candidates are able to choose an appropriate presentation format for the type of data being presented. There is no need for these present formats to be of different types.

Candidates should be reminded that at least one of the presentation formats must be a graph, table, chart or diagram.

Labelling of graphs, tables, charts or diagrams

Successful candidates achieved a mark for including appropriate units, headings and labels for all of the presented and processed data. Candidates who omitted, for example, to label axes or include table headings failed to achieve this mark.

Centres should advise candidates to check thoroughly that they have included all appropriate units, headings and labels for all of their presented, processed data. These should be consistent with the raw data provided and care should be taken that, by omission or addition, the sense of the labelling is not altered.

Comparison of the data from at least two sources

Successful candidates compared the data from at least two different sources, whether processed or unprocessed, and commented, where appropriate, on any similarities or differences or that no comparison could be made between the sources.

Where no comparison can be made between the sources, candidates should provide an explanation of why the sources cannot be compared.

In advising candidates on the choice of research topic, centres should encourage candidates to select topics that lend themselves to sourcing data which can be compared.

Centres should provide guidance to candidates relating to the difference between the comparison between sources and the conclusion that can be made from them.

Drawing a valid conclusion

Successful candidates accessed this mark by providing a conclusion that related to the aim and supported this conclusion with relevant evidence within the report.

Given that some candidates did not state a valid conclusion because it only related to one part of their stated aim, centres should advise candidates not to be 'over ambitious' with the aim of their assignment and to avoid multiple aims.

Apply knowledge and understanding of physics

Successful candidates were able to access these marks by showing a good comprehension of the research and application, and providing an explanation that included a discussion of some of the physics involved at a depth appropriate to National 5.

Again, careful advice on the choice of topic is essential here. Many candidates may wish to choose an area that really interests them. However, it was clear that some chose topics for which the underlying physics was well above National 5 level. Consequently, they struggled to explain the physics or ended up copying verbatim from references.

Similarly, advice on topic choice should also be given to candidates wishing to investigate topics with little or no appropriate physics content, but which could be interpreted more as biological or sociological investigations.

Structure of the report

Successful candidates who achieved all available marks:

- had a heading or title at the start of the report
- included at least two references to the sources used in the report in sufficient detail to allow them to be retrieved by a third party
- produced a report that was clear and concise

Some candidates did not access all marks because:

- they did not include an appropriate heading or title at the start of the report
- they did not provide at least two references to the sources used in the report in sufficient detail to allow them to be retrieved by a third party
- they provided references which were incomplete
- their report was not clearly or logically presented, making it difficult to identify each section of the report
- their report was not concise and contained great amounts of written text which was not relevant to the aim of the research

Centres should ensure that candidates know what is meant by 'in sufficient detail to allow them to be retrieved by a third party' — ie it must be the full URL for a website; for a text

book it should have title, author, page number, and either edition number or ISBN; and for an experimental source it should be a title and aim for the experiment.

Resource packs

It is appreciated that some centres have to use centre-produced resource packs for candidates to undertake the assignment. It is important that such packs contain a range of sources, possibly including ‘red herrings’, from which candidates can make their own selection of data/information. The experience for the candidate should replicate, as far as possible, being able to access websites, textbooks or journals, so the candidate has to extract the appropriate data from the article, rather than the teacher/lecturer having pre-selected only the relevant table of data, graph, etc from the website, manufacturer’s data sheet, journal, etc. Centres should not direct candidates as to which data/information within the pack that they should be choosing. Data/information in resource packs should be real information that candidates could potentially access, rather than fictitious articles, simulations (which give ideal data), etc.

Grade Boundary and Statistical information:

Statistical information: update on Courses

Number of resulted entries in 2015	14942

Number of resulted entries in 2016	14888

Statistical information: Performance of candidates

Distribution of Course awards including grade boundaries

Distribution of Course awards	%	Cum. %	Number of candidates	Lowest mark
Maximum Mark -				
A	31.3%	31.3%	4667	69
B	23.5%	54.9%	3504	58
C	19.1%	74.0%	2845	48
D	8.1%	82.1%	1203	43
No award	17.9%	-	2669	-

General commentary on grade boundaries

- While SQA aims to set examinations and create marking instructions which will allow a competent candidate to score a minimum of 50% of the available marks (the notional C boundary) and a well prepared, very competent candidate to score at least 70% of the available marks (the notional A boundary), it is very challenging to get the standard on target every year, in every subject at every level.

- Each year, SQA therefore holds a grade boundary meeting for each subject at each level where it brings together all the information available (statistical and judgemental). The Principal Assessor and SQA Qualifications Manager meet with the relevant SQA Business Manager and Statistician to discuss the evidence and make decisions. The meetings are chaired by members of the management team at SQA.

- The grade boundaries can be adjusted downwards if there is evidence that the exam is more challenging than usual, allowing the pass rate to be unaffected by this circumstance.

- The grade boundaries can be adjusted upwards if there is evidence that the exam is less challenging than usual, allowing the pass rate to be unaffected by this circumstance.

- Where standards are comparable to previous years, similar grade boundaries are maintained.

- An exam paper at a particular level in a subject in one year tends to have a marginally different set of grade boundaries from exam papers in that subject at that level in other years. This is because the particular questions, and the mix of questions, are different. This is also the case for exams set in centres. If SQA has already altered a boundary in a particular year in, say, Higher Chemistry, this does not mean that centres should necessarily alter boundaries in their prelim exam in Higher Chemistry. The two are not that closely related, as they do not contain identical questions.

- SQA's main aim is to be fair to candidates across all subjects and all levels and maintain comparable standards across the years, even as arrangements evolve and change.