# Course report 2023

## National 5 Physics

This report provides information on candidates' performance. Teachers, lecturers and assessors may find it useful when preparing candidates for future assessment. The report is intended to be constructive and informative, and to promote better understanding. You should read the report in conjunction with the published assessment documents and marking instructions.

The statistics in the report were compiled before any appeals were completed.

# Grade boundary and statistical information

## Statistical information: update on courses

Number of resulted entries in 2022: 13,208

Number of resulted entries in 2023: 13,237

## Statistical information: performance of candidates

### Distribution of course awards including minimum mark to achieve each grade

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| **A** | Number of candidates | 4,597 | Percentage | 34.7 | Cumulative percentage | 34.7 | Minimum mark required | 65 |
| **B** | Number of candidates | 2,623 | Percentage | 19.8 | Cumulative percentage | 54.5 | Minimum mark required | 52 |
| **C** | Number of candidates | 2,169 | Percentage | 16.4 | Cumulative percentage | 70.9 | Minimum mark required | 40 |
| **D** | Number of candidates | 2,047 | Percentage | 15.5 | Cumulative percentage | 86.4 | Minimum mark required | 27 |
| **No award** | Number of candidates | 1,801 | Percentage | 13.6 | Cumulative percentage | 100 | Minimum mark required | N/A |

Please note that rounding has not been applied to these statistics.

You can read the general commentary on grade boundaries in the appendix.

In this report:

- ‘most’ means greater than 70%
- ‘many’ means 50% to 69%
- ‘some’ means 25% to 49%
- ‘a few’ means less than 25%

You can find more statistical reports on the statistics and information page of SQA’s website.

# Section 1: comments on the assessment

## Question paper

All questions were answered correctly by at least a proportion of the candidates, and there was a spread of performance across the range of available marks.

The general feedback from centres and markers was that the question paper included appropriate questions to provide good discrimination for candidates performing across all grades. Statistical analysis indicates that average marks were similar compared to the 2022 question paper, but with a wider distribution.

There was evidence of candidates being presented at an inappropriate level and statistical analysis shows that a number of candidates achieved marks well below the grade C boundary.

In section 1 (objective test) questions 4 and 8 were more demanding than expected, and in section 2 (restricted and extended-response questions), questions 2(a), 2(b)(iii) and 14(a)(ii) were more demanding than expected. The grade boundaries were reduced to take account of this.

Candidates coped well with questions requiring the selection of a relationship, followed by a calculation and final answer.

In general, questions requiring justifications, descriptions or explanations are intended to be more demanding for candidates. There was often a lack of precision in candidates' responses, especially when using physics terminology and principles. Candidates who successfully answered questions that required justifications, descriptions or explanations were able to structure their answers to present information that was clear and relevant to the question being asked. They used correct terminology and referred to appropriate physics concepts (for example, in question 6(b)(ii), the effect of adding a resistor in parallel to the current in a circuit).

The standard of written English was sometimes poor. Some candidates were not using appropriate scientific terminology, and, in some cases, poor spelling or handwriting made it difficult to interpret whether the candidate's response was correct.

## Assignment

The assignment component was removed for session 2022–23.

# Section 2: comments on candidate performance

## Areas that candidates performed well in

### Question paper

**Section 1: objective test**

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| Question 1 | Most candidates were able to complete the passage about vector quantities using the correct words. |
| Question 3 | Many candidates determined the distance travelled by the runner correctly, from the information provided in the velocity-time graph. |
| Question 6 | Many candidates were able to calculate the ‘no greenhouse’ temperature of Earth, using the information provided. |
| Question 7 | Many candidates identified that Doris is an asteroid. A few candidates did not take into account that Doris is described as having an ‘irregular’ shape, and misidentified Doris as a dwarf planet. |
| Question 9 | Most candidates were able to determine the charges on the particle and plates. |
| Question 10 | Most candidates were able to identify a definition of alternating current (a.c.). |
| Question 14 | Most candidates calculated the energy used by the slow cooker correctly. |
| Question 15 | Many candidates determined the voltage across the resistor correctly, given the information provided in the graph of power against resistance. |
| Question 16 | Many candidates identified the measurements that must be made to determine the specific heat capacity of copper in the experiment described. A few candidates responded, incorrectly, that the power rating of the electrical heater must also be measured. |
| Question 18 | Many candidates calculated the area of the nail hit by the hammer correctly. |
| Question 22 | Many candidates identified the diagram that shows the diffraction of water waves as they pass through a gap in a barrier. |
| Question 24 | Many candidates determined the number of nuclei decaying in the stated time correctly. |
| Question 25 | Many candidates identified that the only correct statement made by the student is ‘Plasma containment is required to sustain nuclear fusion reactions in a reactor’. |

**Section 2: restricted and extended-response questions**

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| Question 1(a)(i) | Many candidates calculated the magnitude of the displacement of the seagull correctly. |
| Question 1(b)(i) | Most candidates were able to calculate the magnitude of the average velocity of the seagull correctly. However, most candidates did not include the direction of this velocity in their final answer. |
| Question 1(c)(i) | Most candidates showed all the stages of the calculation required to determine the gravitational potential energy of the chip, given information about its mass and height from which it was dropped. These stages included starting with a correct relationship, making the correct substitutions, and ending with the correct final value, including the unit. |
| Question 2(c)(i) | Most candidates selected the correct relationship between force, mass and acceleration to determine the acceleration of the cyclist and bike. Many also determined the unbalanced force acting on the cyclist and bike and went on to substitute this value into the relationship to achieve a correct final answer. |
| Question 2(c)(ii) | Many candidates were able to explain the advantage of cycling behind a team-mate in terms of reducing friction or air resistance. A few candidates stated incorrectly that cycling behind a team-mate would remove all the friction or air resistance. |
| Question 3(a) | Many candidates were able to identify Astra 1KR as the satellite that remains above the same point on Earth's surface at all times, by identifying it as a geostationary satellite, or by stating its orbital altitude or orbital period. A few candidates made incorrect statements in their justification (for example, 'the satellite has the same orbital period as the Earth', 'the satellite does not move', or 'the satellite moves at the same speed as the Earth'). |
| Question 3(b) | Most candidates were able to calculate the weight of the satellite correctly. |
| Question 3(c) | Most candidates were able to predict the orbital period of the satellite. |
| Question 5(b) | Most candidates were able to determine the elements present in the star, from the information provided in the spectra. |
| Question 6(a) | Many candidates were able to determine the reading on the ammeter correctly. |

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| Question 6(b)(i) | Many candidates were able to determine the total resistance of the circuit containing a combination of resistors in series and parallel. A few candidates who attempted to amalgamate all the stages of the calculation into one relationship started their response with an incorrect statement of the relationship for the total resistance of the circuit. A few candidates misaligned the subscripts in their relationships so that they became superscripts (see Physics: General marking principles, Issue 11). |
| Question 6(b)(ii) | Many candidates were able to identify that the reading on the ammeter will be greater and attempted to justify this effect in terms of a decrease in resistance. However, only some of these candidates made it clear that it was the total resistance of the circuit that had decreased and therefore achieved both marks available. |
| Question 7(a) | Most candidates produced graphs with suitable scales, labels, and units. Most candidates were also able to plot their points accurately to within half a division. However, a few candidates used overly large markers or 'blobs' to indicate their points, the accuracy of which could therefore not be determined (the use of a neat 'x' to indicate their points would have avoided this). Some candidates were able to draw a suitable best fit curve through their points, which was appropriate for the data provided in the question. However, the curves produced by some candidates were drawn too carelessly. For example, passing too far away from many of the points, having multiple lines, or having significant inflections in their curves. |
| Question 8(b) | Most candidates were able to suggest at least one reason why the time taken to heat the ceramic plates is different to the time taken to heat the titanium plates. |
| Question 9(a)(ii) | Many candidates were able to calculate the volume of the gas inside the crips packet at the new pressure correctly. |
| Question 10(b)(i) | Many candidates showed all the stages of the calculation required to determine the frequency of the sound wave, given information provided in the oscilloscope trace. These stages included starting with a correct relationship, making the correct substitutions, and ending with the correct final value, including the unit. |
| Question 10(b)(ii) | Many candidates were able to explain why the time taken between this sound wave being emitted and detected is the same as that taken by the sound wave in the first part of the question. |
| Question 11(a) | Most candidates were able to state the names of the missing parts of the electromagnetic spectrum. The most common error was to transpose the names of the parts. |

Question 11(b) Most candidates were able to identify that radio waves experience the greatest amount of diffraction, and many were able to justify this by identifying radio waves as having the longest wavelength, or lowest frequency.

Question 11(c)(i)(A) Many candidates showed all the stages of the calculation required to determine the wavelength of the electromagnetic waves, given the information provided about their frequency. These stages included starting with a correct relationship, making the correct substitutions, and ending with the correct final value, including the unit.

Question 11(c)(i)(B) Many candidates were able to identify the part of the electromagnetic spectrum that the waves belong to.

Question 11(c)(ii)(A) Most candidates selected the correct relationship to calculate the energy of the radiation absorbed by the patient's head, and many stated a correct final answer and unit. The most common reason for not achieving all the marks available in this question was unit conversion errors involving the 'micro-' prefix (see Physics: general marking principles, Issue 5a).

## Areas that candidates found demanding

### Question paper

#### Section 1: objective test

Question 4 Some candidates correctly calculated the work done by the pushing force in moving the block up the slope. Some candidates used the unbalanced force acting on the block to determine the work done by the pushing force, which is incorrect, as it does not take into account that work also needs to be done against friction by the pushing force.

Question 5 Some candidates were able to determine the increase in kinetic energy of the trolley.

Question 11 Some candidates determined the resistance of the resistor in series with the LED correctly. Some candidates simply divided the voltage across the LED by the current in the LED to determine the resistance of the LED, rather than that of the resistor.

Question 13 Some candidates were able to identify the circuit that switches on a motor when the light level drops below a certain value, as required. Some candidates selected the circuit that switches on a motor when the light level rises above a certain value.

Question 23 Some candidates were able to identify the path of the red light in air. Some candidates incorrectly selected the path where the red light appears to 'reflect' from the normal.



 

**Section 2: restricted and extended-response questions**

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| Question 1(a)(ii) | Many candidates were able to calculate an appropriate angle, but some were unable to then express their answer as a three-figure bearing or as an angle relative to a compass point. There were a few examples of responses starting with incorrect statements of trigonometric relationships (for example, $\theta = tan\left(\frac{63}{24}\right)$, rather than $\theta = tan^{-1}\left(\frac{63}{24}\right)$. |
| Question 1(b)(ii) | Some candidates were able to identify that the distance travelled by the seagull was greater than its displacement, but only a few also stated that the time taken was the same. |
| Question 1(c)(iii) | Only a few candidates were able to explain why, in practice, the vertical speed of the chip as it reaches the ground is less than calculated in the previous part of the question, by associating air resistance or friction with energy loss. Often candidates provided incomplete explanations, such as 'due to energy loss' or 'because of air resistance', without linking these two concepts. |
| Question 2(a) | Some candidates were able to sketch the path taken by the bottle correctly, as observed by the spectator at the side of the road. However, many sketched the path, as observed by the cyclist (either with or without including the effect of air resistance). |
| Question 2(b)(ii) | Some candidates were able to sketch the shape of the velocity-time graph correctly (a straight line with a positive gradient, starting at the origin), and some candidates were able to sketch graphs that ended at the correct numerical values (or values consistent with their answer to the previous part of the question). However, few candidates were able to sketch a graph that included both these aspects correctly. |
| Question 2(b)(iii) | Only a few candidates were able to determine the height from which the bottle was dropped correctly. Often candidates who achieved the marks for this question did so by determining the area under the graph that they sketched in the previous part of the question. Candidates who tried to use the relationship between distance, speed, and time to determine the height, frequently did not achieve any marks, as they used the final velocity of the bottle as it reaches the ground in their calculation, rather than its average velocity. |



 

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| Question 4 | Although many candidates identified a benefit or challenge of using a base on the Moon from which humans could explore the solar system and beyond, only a few went on to develop their responses and demonstrate any depth of understanding. Often candidates discussed issues such as expense or general difficulty, which included little or no physics. A few candidates demonstrated good understanding, such as describing in detail the benefit of the lower gravitational field strength on the Moon in terms of the energy required to launch spacecraft, or the challenges of protecting astronauts from increased exposure to radiation. There were a few candidates who made incorrect statements such as 'there is no gravity on the Moon' or that 'due to the lower gravity on the Moon space bases might float away'. |
| Question 5(c) | Only some candidates showed all the stages of the calculation required to determine the distance to the star in metres, given its distance in light-years. Many candidates omitted to include a correct relationship in their response. |
| Question 7(c) | Some candidates were able to suggest at least one way in which the experimental procedure could be improved, but few could suggest two. Although many candidates suggested repeating measurements, only some included that repetition should be accompanied by a calculation of the mean or average. |
| Question 9(a)(i) | Only a few candidates were able to state what is meant by the term pressure. Many candidates stated imprecise definitions such as 'the force over an area' or 'the force on a specific area'. |
| Question 9(a)(iii) | Only a few candidates were able to describe how the kinetic model accounts for the pressure of the gas inside the crisp packet, ie by discussing the collision of the gas particles with the walls of the container. Some candidates attempted to explain the changes in pressure and volume terms of the gas laws but omitted to mention anything about the kinetic model in their response. |
| Question 9(b) | Most candidates selected (or implied) a correct relationship to determine the equivalent dose received by the crew, but only a few ended up with a correct final answer and unit. Issues resulting in incorrect final answers included converting the time in hours into seconds before substitution into the relationship (which was not required as the equivalent dose rate was given in microsieverts per hour) and unit conversion errors involving the 'micro-' prefix (see Physics: general marking principles, Issues 5a and 5b). |



 

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| Question 10(a) | Most candidates selected a correct relationship to determine the distance between the car and the wall, but only some took account of the fact that the sound was being reflected to obtain a correct final answer. A few candidates used the speed of light in their calculation rather than the speed of sound. |
| Question 12 | Many candidates were able to demonstrate at least a limited understanding of physics by simply comparing the behaviour of the students with arms linked together to the refraction of light in terms of associating a change in medium with a change in speed, direction, or wavelength. However, only few candidates were able to demonstrate a good understanding of the physics involved by linking these ideas together to provide a coherent explanation of the analogy. |
| Question 13(a) | Many candidates selected the correct radioactive source, but only some justified their selection by associating the effect of the various absorbing materials with the type of radiation being emitted. |
| Question 13(b)(i) | Only some candidates were able to state what is meant by the term ionisation. Common issues included omitting key words such as ‘electrons’ and/or ‘atoms’ from responses. |
| Question 13(b)(iii) | Many candidates were able to calculate the total charge transferred between the wire and the grid, using the relationship between current, charge and time. However, only a few candidates went on to determine average charge transferred during each spark, by dividing the total charge transferred by the number of sparks. A few candidates were able to determine the charge transferred by each spark correctly by alternative methods, such as determining the time for one spark and substituting this value into the current, charge and time relationship. |
| Question 14(a)(i) | Although many candidates mentioned background radiation in their response, few candidates were specific in stating that the additional measurement that must have been made in order to determine the corrected count rate was the ‘background count rate’ or ‘background count’. |
| Question 14(a)(ii) | Some candidates were able to determine the half-life of iodine-125 from the graph. Common incorrect answers included 50 days (the starting point of the graph) and 110 days (the number of days after implant on which the corrected count rate has reduced to half of the starting value shown at 50 days after implant in the graph). |



 

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| Question 14(a)(iv) | Few candidates determined a correct or acceptable value for the initial corrected count rate, either by using the value of the half-life they determined in a previous part of the question and combining this with data from the graph, or by extrapolating the graph backwards to determine the corrected count rate on the day the capsule was implanted. A common error was to omit the unit for the corrected count rate. |
| Question 14(b) | Only some candidates were able to state a use of nuclear radiation. Common correct responses included ‘smoke detectors’, ‘measuring the thickness of paper’, and ‘tracers’. Responses such as ‘generating power’, ‘nuclear bombs’ or ‘weapons’ are insufficient as they are not a use of nuclear radiation, but a use of nuclear reactions. |

# Section 3: preparing candidates for future assessment

## Question paper

Each year, the question paper samples the full range of course content. 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 relevant course content. The question paper assesses application of knowledge and understanding, and application of the skills of scientific enquiry, scientific analytical thinking and problem solving. Candidates should have the opportunity to practise these skills regularly, to familiarise themselves with the type and standard of questions that may be asked.

Candidates **must** be given the opportunity to take an active part in a wide range of practical work, to develop the necessary knowledge and skills. This will help candidates with questions that ask about experiments and practical contexts. While demonstration of experiments, videos, and computer simulations may be useful additional tools, they cannot replace active experimental work and do not develop the knowledge and skills associated with practical work.

Frequent use of physics terms and 'language' may help candidates develop their communication skills when answering questions.

Candidates should be familiar with the various 'command words' used in physics questions and how to respond to them. For example, when candidates are asked to 'show' a particular answer is correct, they should start their response with an appropriate relationship, 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 be awarded 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 a few candidates confused significant figures with decimal places. Centres should ensure that candidates understand and can use significant figures correctly.

Candidates should be strongly discouraged from copying down answers from their calculator containing a large number of significant figures, or using ellipses, as a penultimate stage in their response before stating their final answer, as often this can introduce transcription or rounding errors into their calculations. They should be strongly encouraged to show only the selected relationship, the substitution, and then the answer, including units, to the appropriate number of significant figures.



 

Candidates should be given the opportunity to practise open-ended questions at appropriate points during the course. They should be encouraged to both state relevant physics concepts and 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 either be generated by their peers or are available from sources such as the SQA Understanding Standards website.

Candidates should ensure that they write as neatly as possible so their answers can be clearly interpreted by markers. They should also check their spelling, particularly for scientific terms such as refraction.

The published marking instructions contain general marking principles, as well as 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.

Centres should also refer to the Physics: general marking principles document on the SQA website for generic issues related to the marking of question papers in SQA qualifications in Physics at National 5, Higher and Advanced Higher levels. Centres must adopt these general instructions for the marking of prelim examinations and centre-devised assessments for any SQA Physics courses.

Centres must ensure candidates are entered at an appropriate level.



 

# Appendix: general commentary on grade boundaries

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

For most National Courses, SQA aims to set examinations and other external assessments and create marking instructions that allow:

- a competent candidate to score a minimum of 50% of the available marks (the notional grade C boundary)
- a well-prepared, very competent candidate to score at least 70% of the available marks (the notional grade A boundary)

It is very challenging to get the standard on target every year, in every subject at every level. Therefore, SQA holds a grade boundary meeting for each course to bring together all the information available (statistical and qualitative) and to make final decisions on grade boundaries based on this information. Members of SQA's Executive Management Team normally chair these meetings.

Principal assessors utilise their subject expertise to evaluate the performance of the assessment and propose suitable grade boundaries based on the full range of evidence. SQA can adjust the grade boundaries as a result of the discussion at these meetings. This allows the pass rate to be unaffected in circumstances where there is evidence that the question paper or other assessment has been more, or less, difficult than usual.

- The grade boundaries can be adjusted downwards if there is evidence that the question paper or other assessment has been more difficult than usual.
- The grade boundaries can be adjusted upwards if there is evidence that the question paper or other assessment has been less difficult than usual.
- Where levels of difficulty are comparable to previous years, similar grade boundaries are maintained.

Grade boundaries from question papers in the same subject at the same level tend to be marginally different year on year. This is because the specific questions, and the mix of questions, are different and this has an impact on candidate performance.

This year, a package of support measures was developed to support learners and centres. This included modifications to course assessment, retained from the 2021–22 session. This support was designed to address the ongoing disruption to learning and teaching that young people have experienced as a result of the COVID-19 pandemic while recognising a lessening of the impact of disruption to learning and teaching as a result of the pandemic. The revision support that was available for the 2021–22 session was not offered to learners in 2022–23.

In addition, SQA adopted a sensitive approach to grading for National 5, Higher and Advanced Higher courses, to help ensure fairness for candidates while maintaining standards. This is in recognition of the fact that those preparing for and sitting exams continue to do so in different circumstances from those who sat exams in 2019 and 2022.

The key difference this year is that decisions about where the grade boundaries have been set have also been influenced, where necessary and where appropriate, by the unique circumstances in 2023 and the ongoing impact the disruption from the pandemic has had on learners. On a course-by-course basis, SQA has determined grade boundaries in a way that is fair to candidates, taking into account how the assessment (exams and coursework) has functioned and the impact of assessment modifications and the removal of revision support.

The grade boundaries used in 2023 relate to the specific experience of this year's cohort and should not be used by centres if these assessments are used in the future for exam preparation.

For full details of the approach please refer to the National Qualifications 2023 Awarding — Methodology Report.