Course report 2023

Higher 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: 8,047

Number of resulted entries in 2023: 7,997

Statistical information: performance of candidates

Distribution of course awards including minimum mark to achieve each grade

A	Number of candidates	2,725	Percentage	34.1	Cumulative percentage	34.1	Minimum mark required	81
B	Number of candidates	1,962	Percentage	24.5	Cumulative percentage	58.6	Minimum mark required	66
C	Number of candidates	1,490	Percentage	18.6	Cumulative percentage	77.2	Minimum mark required	52
D	Number of candidates	1,059	Percentage	13.2	Cumulative percentage	90.5	Minimum mark required	37
No award	Number of candidates	761	Percentage	9.5	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

Feedback from teachers, lecturers, and candidates indicated that they felt the papers were fair and accessible.

Both question paper 1 and question paper 2 performed largely as expected.

Adjustments were made to grade boundaries to take account of a number of issues.

An adjustment was made to the grade boundaries for question 5(b)(iii)(B), as it was considered to be more demanding than intended. Question 7(b)(ii) also did not perform as expected and an adjustment was made to the grade boundaries to account for this.

Many candidates were unable to answer questions that related to practical work, including questions related to particular experiments detailed in the course specification. This included question 15 in paper 1 and question 8 in paper 2.

While it was clear that some candidates had participated in a range of practical work, it was evident that others had little or no experience of practical work, or perhaps had only watched videos or simulations, and had therefore not developed the necessary knowledge and skills.

Assignment

The assignment was removed for session 2022-23.

Section 2: comments on candidate performance

Areas that candidates performed well in

Question paper

Question paper 1

Question 1	Most candidates could identify the correct acceleration-time and displacement-time graphs given a velocity-time graph.
Question 3	Most candidates could calculate the kinetic energy of an object given its mass and momentum.
Question 5	Most candidates could determine the horizontal and vertical components of the ball's velocity.
Question 7	Most candidates were able to answer the relativistic time dilation calculation correctly.
Question 8	Most candidates knew that the accelerating rate of expansion of the Universe was evidence supporting the existence of dark energy.
Question 9	Many candidates were able to identify which of the statements about stellar objects were correct.
Question 10	Most candidates could identify the correct electric field pattern.
Question 11	Most candidates could identify that a neutron is a baryon.
Question 12	Most candidates could calculate the energy released during a fusion reaction.
Question 13	Most candidates were able to identify which of the statements about wave particle duality were correct.
Question 14	Most candidates could identify that the frequency of the incident radiation was too low for photoelectric emission to occur.
Question 16	Most candidates could calculate the wavelength from the path difference.
Question 21	Many candidates were able to determine the internal resistance and the EMF of the battery.
Question 22	Many candidates were able to identify that a coulomb per volt is equivalent to a farad.
Question 23	Many candidates were able to identify which of the statements about metals, insulators, and semiconductors were correct.

Question 25	Most candidates were able to use the unfamiliar relationship to calculate the mass of the string.

Question paper 2

Question 1(a)	Most candidates could calculate the distance travelled by the van during braking.
Question 1(b)	Most candidates could calculate the time taken for the van to come to rest.
Question 1(c)	Many candidates could complete the sketch graph of the van's motion during braking.
Question 2(a)	Most candidates could show how to calculate the acceleration of the bike and trailer. Of those who could not, most either did not show how they arrived at the unbalanced force or the total mass of the system.
Question 3(a)	Most candidates could calculate the velocity of the car X immediately after the collision.
Question 3(b)	Many candidates were able to determine the total kinetic energy before the collision and the total kinetic energy after the collision. Some candidates were not awarded the final mark as they did not state that the total kinetic energy was greater before the collision than after the collision.
Question 4(a)	Most candidates could determine the speed of train B relative to train A.
Question 4(c)(ii)	Most candidates could calculate the length of the train as measured by the stationary observer.
Question 5(a)(i)	Most candidates could calculate the frequency of the sound heard by the person.
Question 5(a)(ii)	Most candidates could state what happens to the frequency and many could justify their answer. Some candidates were successfully justifying their answer by calculation.
Question 5(b)(iii)(A)	Many candidates were able to determine the energy of the emitted photon.
Question 6	This is the first of the open-ended questions in the exam. Candidates produced a range of answers to this question, and it appears to have been accessible to most candidates.
Question 7(a)(i)(A)	Many candidates could determine the atomic number of the element.

Question 7(a)(i)(B)	Most candidates could identify the element with the atomic number they stated in part (A).
Question 7(a)(ii)(A)	Many candidates could state that electrons were leptons.
Question 7(a)(ii)(B)	Many candidates could identify that the weak force is associated with beta decay.
Question 8(b)(ii)	Many candidates could use the data appropriately to help establish the relationship. However, some were not then going on to state what the relationship was.
Question 9	This is the second open-ended question. Performance in this question was similar to question 6, with most candidates finding it accessible.
Question 10(c)(i)	Most candidates could state the number of lines produced from the energy level diagram.
Question 10(c)(ii)(A)	Many candidates could calculate the frequency of the emitted photon.
Question 10(c)(ii)(B)	Most candidates could state the wavelength of the photon given the colour.
Question 10(c)(ii)(C)	Many candidates could determine the observed wavelength of the spectral line.
Question 11(a)(i)	Most candidates could calculate the angle of refraction inside the prism.
Question 11(b)(ii)	Most candidates could calculate the critical angle.
Question 12(a)(i)	Many candidates could determine the terminal potential difference of the battery.
Question 12(a)(ii)	Many candidates could calculate the internal resistance of the battery.
Question 12(a)(iii)	Many candidates could calculate the power dissipated by the internal resistance of the battery.
Question 13(a)(i)	Most candidates could calculate the capacitance of the capacitor.
Question 13(b)	Many candidates could calculate the time taken for the capacitor to charge. However, a significant number of candidates could not correctly use the value they had calculated in part (a)(i) in this part of the question.
Question 14(a)	Many candidates could draw the graph. There are still a number of candidates not choosing sensible scales for their axes and this led to difficulties when plotting points and in later parts of this question.

Areas that candidates found demanding

Question paper

In general, it was noted that candidates had more difficulty with questions that asked about practical work.

Another issue identified in the advice given in previous course reports was the need to learn definitions. While there have been small improvements in the standard of the answers to these questions, many candidates can still not give the definition of critical angle or state the features of the Bohr model of the atom.

The standard of writing and literacy was often poor. In some questions, candidates were using language that lacked the necessary precision.

Question paper 1

Question 2	Some candidates could correctly calculate the initial velocity of the balloon. However, many candidates did not take the vector nature of velocity into account. This resulted in them choosing an incorrect answer.
Question 4	Some candidates realised that, by applying conservation of energy, to double the speed of the pendulum bob, the height of release had to increase by a factor of 4.
Question 6	Many candidates were unable to calculate the gravitational force between a satellite and the Earth.
Question 15	Few candidates could determine the correct number of maxima that are observed on the screen. Many candidates did not include the central maximum.
Question 17	Many candidates could not select the appropriate graph showing the relationship between frequency and wavelength of photons.
Question 18	Many candidates realised that the speed and the wavelength of the waves would increase but only some could identify the path the ray of light would follow.

Question paper 2

Question 2(b)	Although most candidates could calculate the unbalanced force, many did not take the friction into account when determining the tension.
Question 2(c)	Some candidates could state that the tension would increase but few could justify their answer.

Question 3(c)	Many candidates did not answer the question that was asked. Candidates were asked to calculate the force that car X exerted on car Y but instead calculated the force of car Y on X. Few candidates who took this approach made it clear that the magnitude of the force car Y exerts on car X would be the same as the magnitude of the force car X exerts on car Y.
Question 4(b)	Many candidates were unable to determine the speed of the passenger on train A relative to the passenger on train B.
Question 5(b)(i)	Many candidates were unable to determine the period of the AC supply having been told that the LEDs flashed twice per second.
Question 5(b)(ii)	Many candidates were not being precise enough in the terminology they used when answering this question. Candidates did not demonstrate an understanding of what is meant by forward and reverse bias, with some saying that one set of LEDs conducted when forward biased and the other set when reverse biased.
Question 5(b)(iii)(B)	Few candidates were able to explain, in terms of the energy band gaps, the difference between the photons emitted by the different LEDs. Many candidates did not refer to the energy band gaps in their answer.
Question 7(b)(ii)	Few candidates could explain why an alternating voltage is used in a cyclotron. Many candidates supplied an answer that would have been correct if they had been asked about a linear accelerator. For example, candidates were stating that an AC supply is used in a cyclotron to keep the force on the particle in the same direction when they should have stated that it kept the force in the correct direction.
Question 8(a)	Few candidates could describe an experiment to verify the inverse square law for a point source of light. This is one of the experiments that candidates are required to be able to describe.
Question 8(c)	Few candidates could explain why the irradiance decreased with distance from a point source of light.
Question 10(a)	Few candidates could name a feature of the Bohr model of the hydrogen atom. Some candidates were answering this question in terms of other models of the atom. Others were stating that a hydrogen atom had (multiple) protons in the nucleus when a hydrogen atom has only one proton in its nucleus.
Question 10(b)(i)	Few candidates could explain how an emission spectrum is produced. Many candidates were answering this question by describing how an absorption spectrum is produced.

Question 10(b)(ii) Few candidates could explain why some of the lines in the spectrum appear brighter than others. This issue was also highlighted in last year's course report.

Question 11(a)(ii) Many candidates were unable to determine angle B correctly. The skills required to do this will have been acquired during the broad general education.

Question 11(b)(i) Most candidates were unable to provide the correct definition of critical angle. Some candidates are still giving an incorrect definition in terms of total internal reflection.

Question 11(c) Many candidates could not complete the diagram to show the path of the ray of light fully. Where candidates had made errors in determining angle B and/or the critical angle, these errors were allowed to be carried forward into part (c).

Question 12(b) Few candidates could state and justify the effect on the power dissipated by the internal resistance of the battery when the circuit was rearranged.

Question 13(a)(ii) Few candidates could correctly determine the absolute uncertainty in the capacitance. A number of candidates were able to calculate the percentage uncertainties in the measurement quantities but were unable to go on to find the absolute uncertainty.

Question 14(b) Only some candidates could calculate the gradient of their graph correctly. A significant number of candidates did not take account of the 10^{14} in the frequency values, despite having written the value correctly on the axis of their graph.

Question 14(c) Few candidates could use the gradient of their graph to calculate Planck's constant. A significant number of candidates were substituting data points into the equation, rather than points on their line, to get a value which meant they were not answering the question.

Question 14(d) Few candidates could suggest an appropriate improvement to the experiment.

Section 3: preparing candidates for future assessment

Question paper

Candidates **must** be given the opportunity to take an active part in a wide range of practical work throughout the course and evaluate and analyse as appropriate, to develop the necessary knowledge and skills. 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. Opportunities to regularly practise experimental skills during classwork should enable candidates to answer questions assessing aspects of experimental technique and analysis of experimental data.

Candidates should be encouraged to learn the definitions required for Higher Physics.

Candidates should be encouraged to read the questions carefully and answer the question that is being asked.

Candidates should be able to correctly describe the operation of LEDs in circuits.

Candidates should be able to describe the operation of cyclotrons as well as the operation of linear accelerators.

Candidates should learn the features of the Bohr model of the hydrogen atom.

Candidates should know the difference between emission and absorption spectra and how they are produced.

When comparing the brightness of lines in a line spectrum, candidates should be able to state that the brightness of a line is related to the number of electrons making a particular transition per second, hence producing that number of photons per second.

Candidates should be given opportunities to practise their mathematical skills when considering the path of a ray of light through a transparent object.

Candidates should be given opportunities to analyse uncertainties associated with experimental data.

Candidates should be given opportunities to determine the gradient of graphs derived from practical work and then use the gradient to find physical constants.

When carrying out practical work, candidates should be given opportunities to discuss practical improvements to their experiments.

Candidates should be encouraged to make handwriting as clear as possible.

In the examination, candidates should also be encouraged to refer to the data sheet and to the relationships sheet, rather than trying to remember data and relationships.

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.

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.

