Course report 2022

Subject	Physics
Level	Higher

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. It would be helpful to read this report in conjunction with the published assessment documents and marking instructions.

The statistics used in this report have been compiled before the completion of any appeals.

Grade boundary and statistical information

Statistical information: update on courses

Number of resulted entries in 2022	**8045**

Statistical information: performance of candidates

Distribution of course awards including grade boundaries

A	Percentage	37.0	Cumulative percentage	37.0	Number of candidates	2975	Minimum mark required	80
B	Percentage	22.9	Cumulative percentage	59.9	Number of candidates	1845	Minimum mark required	65
C	Percentage	18.0	Cumulative percentage	77.9	Number of candidates	1450	Minimum mark required	50
D	Percentage	12.0	Cumulative percentage	89.9	Number of candidates	965	Minimum mark required	35
No award	Percentage	10.1	Cumulative percentage	N/A	Number of candidates	815	Minimum mark required	N/A

You can read the general commentary on grade boundaries in appendix 1 of this report.

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 page of SQA’s website.

Section 1: comments on the assessment

Question paper

Both question paper 1 and question paper 2 performed largely as expected. However, there were some candidates who appeared to have been presented at an inappropriate level, as they struggled to access most of the questions.

It was clear that 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 2 in paper 1, and questions 3(c) and 8(b)(iii) 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 2021–22.

Section 2: comments on candidate performance

Question paper 1

Question 1	Most candidates could identify the correct velocity-time graph given an acceleration-time graph.
Question 2	Many candidates gave answers indicating that the displacement s was the length of the card and/or the final speed was found by taking the distance between P and Q and dividing by the time to pass through the light gate. Candidate responses suggest that they were not familiar with this experiment, despite measuring the acceleration of an object down a slope being listed in the mandatory course content.
Question 3	Many candidates could calculate the component of the weight of the package parallel to the ramp.
Question 4	Most candidates managed to analyse the tied system well.
Question 5	Some candidates were able to determine the reading on the newton balance. This was intended to be a grade A mark and worked as such.
Question 6	Many candidates were able to calculate the power dissipated by the water falling over the Victoria Falls.
Question 7	Most candidates coped well with the relativistic time dilation calculation.
Question 8	Many candidates were able to select the correct statements about the expanding Universe.
Question 9	Most candidates were able to calculate the frequency of sound heard by the observer.
Question 10	Many candidates were able to determine the direction of the force on the proton as it entered the magnetic field.
Question 11	Most candidates determined the correct order of magnitude.
Question 12	Some candidates could identify that protons can be classified as baryons, hadrons, and fermions. However, the number who could do so was disappointing, despite this being a straightforward question. Some candidates did not know that protons can be classified as fermions, and a few did not know that they can be classified as baryons or hadrons.
Question 13	Many candidates could determine which nucleus corresponded to nucleus X in the decay statement.

Question 14	Most candidates could calculate the energy released in the nuclear reaction.
Question 15	Most candidates coped well with calculating the irradiance of light from a point source given a change in distance.
Question 16	A few candidates could select the correct statements related to the interference pattern. This was intended to be a grade A mark and worked as such.
Question 17	Many candidates could select the appropriate row in the table, showing what happens to speed, frequency, and wavelength when light passes from diamond into air.
Question 18	Many candidates could determine the rms voltage and frequency of the output from the signal generator.
Question 19	Most candidates could determine the power dissipated in the circuit.
Question 20	Many candidates were able to determine the total circuit resistance and the potential difference across XY.
Question 21	Many candidates were able to determine the lost volts due to the internal resistance of the battery.
Question 22	Some candidates were able to determine the reading on the voltmeter. This was intended to be a grade A mark and worked as such.
Question 23	Many candidates were able to identify the appropriate set of graphs for a capacitor whilst it is charging, although not as many as would usually be the case with this type of question.
Question 24	Many candidates could recall that the conduction band is unfilled in an insulator and that the band gap is large.
Question 25	Most candidates were able to use the unfamiliar relationship to calculate the mass of the Triangulum galaxy.

Question paper 2

Question 1(a)(i)(A), (B)	Most candidates could calculate the rectangular components of the velocity vector.
Question 1(a)(ii)	Most candidates could show that the time for the football to travel to the crossbar was 0.71 s.
Question 1(a)(iii)	Many candidates could calculate the height h at which the football hits the crossbar.

Question 1(b)	Many candidates could identify that the ball would pass under the crossbar. However, many could not explain sufficiently why that was the case. Some candidates simply repeated information from the question by stating that the initial velocity had been reduced.
Question 2(a)(i)	Many candidates could calculate the acceleration of the puck.
Question 2(a)(ii)	Most candidates could calculate the magnitude of the force.
Question 2(b)	Most candidates could not identify that the percentage uncertainty was the important factor when determining the overall uncertainty in the final measured quantity.
Question 3 (a)(i)	Most candidates could state an acceptable relationship, but some candidates could not substitute the values into the relationship correctly.
Question 3(a)(ii)	Most candidates could calculate the time of the interaction correctly.
Question 3(b)	Many candidates could calculate the velocity of the trolley after the interaction correctly.
Question 3(c)	Most candidates could not explain how to determine whether the interaction was elastic. Many candidates failed to mention that it was the total kinetic energy that was significant.
Question 3(d)(i)	While there has been a small improvement in the number of candidates who can identify the photovoltaic effect correctly, many candidates could not name the effect.
Question 3(d)(ii)	A notable number of candidates answered this question by describing the operation of an LED rather than a photodiode. Both the operation of LEDs and photodiodes are listed in the mandatory content of the course.
Question 4	In both open-ended questions a number of excellent answers were provided by candidates.
Question 5(a)	Candidates who drew an annotated diagram found it easier to access the marks. Some of those who did not include an annotated diagram made no mention of wavefronts in their answer.
Question 5(b)(i)	Candidates did particularly well when asked to calculate the redshift of the star.
Question 5(b)(ii)	This multistage calculation to find the distance between Earth and the star system was done well, with many achieving full marks. Only a few candidates scored fewer than 4 out of 5 marks.

Question 5(c)(i)	A notable number of candidates missed the squared sign in their substitution of values into the relationship, despite the issue being highlighted in the revision support for candidates.
Question 5(c)(ii)	Candidates did well when asked to state the quantitative effect on the force when the distance between the stars changed, with many candidates answering correctly.
Question 6(a)	Many candidates could identify a meson correctly.
Question 6(b)(i)	Many candidates were able to name the quarks appropriately. However, some candidates stated incorrectly that the antiparticle of an up quark is a down quark.
Question 6(b)(ii)	Many candidates could identify the weak force.
Question 6(c)(i)	Most candidates could calculate the time for the pion to travel between the two detectors in the stationary observer's frame of reference.
Question 6(c)(ii)	A notable number of candidates substituted incorrectly into the 'length contraction' relationship and ended up with an answer that was longer than the measured length in the observer's frame of reference.
Question 6(d)	Most candidates did not identify a frame of reference in their answer.
Question 6(e)	Some candidates gave imaginative and insightful answers when commenting on the building blocks analogy for the Standard Model.
Question 7(a)	Some candidates simply restated information given in the question as their explanation. Many failed to include mention of the fact that protons are charged.
Question 7(b)(i)	Most candidates answered this show question successfully.
Question 7(b)(ii)	Some candidates could not identify the correct relationship and a few candidates could not identify the charge on the proton.
Question 7(b)(iii)	Many candidates did not add work done to the original kinetic energy to obtain the final kinetic energy of the proton, before attempting to calculate the speed.
Question 7(c)	Most candidates could not justify the effect of increasing the distance between the plates. This was intended to be a grade A question and worked as such.
Question 8(a)(i)	Candidates performed well in determining the area and then using this value to calculate the power of the beam of light.

Question 8(a)(ii)	Few candidates could state that the light from the collimator was not (acting as) a point source of light.
Question 8(b)(i)	Many candidates could identify that the electron was moving to a lower energy level.
Question 8(b)(ii)	Many candidates could calculate the difference in energy between the two energy levels correctly.
Question 8(b)(iii)	Few candidates identified correctly that the line was brighter because more photons were being produced per second.
Question 9(a)	Many candidates could not extrapolate the line on the graph to determine the threshold frequency of the metal.
Question 9(b)	Many candidates found it difficult to link the work functions given in the table to the threshold frequency of the metal.
Question 10(a)	As with question 3(d)(i), there has been an increase in the number of candidates giving this definition correctly but there are still many candidates who cannot state that coherent waves have a constant phase relationship.
Question 10(b)	Many candidates could explain how a maximum is formed.
Question 10(c)	Many candidates could calculate the path length correctly.
Question 10(d)	Many candidates could identify correctly the type of interference being used.
Question 11(a)	Many candidates could calculate the angle required correctly.
Question 11(b)	Candidates did well when asked to calculate the critical angle of the material, with most candidates answering correctly.
Question 11(c)	Of the candidates who could identify the correct point, most could then justify their selection correctly.
Question 12(a)	Many candidates could give the definition of EMF.
Question 12(b)(i)	Many candidates could identify the EMF from the graph correctly.
Question 12(b)(ii)	Many candidates could calculate the internal resistance of the battery correctly. Common mistakes included stating that r is the gradient rather than $-r$ is the gradient.
Question 12(c)	Few candidates could state that to measure the EMF of the cell using the circuit shown, the correct experimental method is to open the switch and take the reading on the voltmeter.

Question 12(d)	Candidates found it difficult to explain the effect of making a change to the experimental set up, with few candidates able to give a suitable explanation.
Question 12(e)	Candidates did well when asked to add a line to the existing graph to show how a different battery of known properties would perform, with most adding an appropriate line. Some candidates did not use a ruler or straight edge when drawing the line.
Question 13(a)	Few candidates could describe how to carry out this experiment. This question is based on one of the experiments identified in the mandatory content of the course.
Question 13(b)(i)	Many candidates could calculate the maximum energy stored in the capacitor correctly.
Question 13(b)(ii)	Many candidates could not suggest a suitable alteration to the circuit.
Question 14(a)	Most candidates could draw the graph from the data provided.
Question 14(b)	Many candidates could not calculate the gradient of their graph. A common error was to use data points that did not lie on their line of best fit.
Question 14(c)	Many candidates could not use the gradient of their graph to determine the gravitational field strength.

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

Despite clear advice not to do so, a significant proportion of candidates are still including unnecessary lines when presenting calculations, such as a penultimate unrounded number before the final answer. Some candidates are making transcription errors or truncating the numbers, leading to incorrect final answers.

Some candidates are demonstrating incorrect intermediate rounding in calculations, despite the clear advice being not to round at an intermediate stage, with the incorrect intermediate rounding often leading to incorrect final answers.

Some candidates are still attempting to draw straight lines without using a ruler.

While there has been some improvement in the standard of the answers to questions requiring candidates to give definitions related to particular physics concepts, many candidates can still not give the definition of coherence, identify the photovoltaic effect, or explain how to establish if a collision is elastic. All of these issues are linked to the learning of definitions, which was highlighted in the revision support.

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

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, 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.

Candidates should learn the definitions required for Higher Physics.

Candidates should be strongly discouraged from including a penultimate line showing an unrounded value in their answers to calculations. This should help them to avoid introducing errors into their answers.

Candidates should be strongly discouraged from rounding at the intermediate stage of a calculation. Only the final answer should be rounded to the appropriate number of significant figures.

Candidates should use a ruler when drawing straight lines.

When comparing uncertainties, candidates should be able to state that it is the percentage uncertainties that should be considered.

Candidates should be able to distinguish between the photoelectric effect and the photovoltaic effect.

When asked questions concerning band theory, candidates should be able to describe both the operation of an LED and a photodiode. Candidates should ensure that they can answer such questions in terms of band theory.

When answering questions on relativistic motion candidates should identify a frame of reference.

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.

Centres should ensure candidates are entered at an appropriate level.

Appendix 1: 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 including assessment modifications and revision support, was introduced to support candidates as they returned to formal national exams and other forms of external assessment. This was designed to address the ongoing disruption to learning and teaching that young people have experienced as a result of the COVID-19 pandemic. In addition, SQA adopted a more generous approach to grading for National 5, Higher and Advanced Higher courses than it would do in a normal exam year, to help ensure fairness for candidates while maintaining standards. This is in recognition of the fact that those preparing for and sitting exams have done so in very different circumstances from those who sat exams in 2019.

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 2022. 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 revision support.

The grade boundaries used in 2022 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 2022 Awarding — Methodology Report.