Course report 2024

Advanced 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 with the published assessment documents and marking instructions.

We compiled the statistics in this report before we completed the 2024 appeals process.

Grade boundary and statistical information

Statistical information: update on courses

Number of resulted entries in 2023: 2,087

Number of resulted entries in 2024: 2,254

Statistical information: performance of candidates

Distribution of course awards including minimum mark to achieve each grade

A	Number of candidates	548	Percentage	24.3	Cumulative percentage	24.3	Minimum mark required	110
B	Number of candidates	574	Percentage	25.5	Cumulative percentage	49.8	Minimum mark required	92
C	Number of candidates	522	Percentage	23.2	Cumulative percentage	72.9	Minimum mark required	74
D	Number of candidates	382	Percentage	16.9	Cumulative percentage	89.9	Minimum mark required	56
No award	Number of candidates	228	Percentage	10.1	Cumulative percentage	100	Minimum mark required	N/A

We have not applied rounding 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 statistical reports on the statistics and information page of our website.

Section 1: comments on the assessment

Question paper

The question paper performed as expected, however, there were still some candidates who may have been presented at an inappropriate level. They therefore struggled to access some of the questions.

There was a small number of questions that proved more challenging than anticipated — in particular, questions 4(c) and 11(c)(i). Grade boundaries were adjusted to take account of these questions.

There is still evidence that some candidates found questions based on experimental technique and data analysis challenging. This is most likely because of a lack of exposure to practical physics at an appropriate level.

The standard of responses to both open-ended questions was similar to that in previous exam papers.

Project

The project returned this session and performed as expected.

Section 2: comments on candidate performance

Areas that candidates performed well in

Question paper

Questions 1(a), (b)	Most candidates were able to differentiate and integrate the given relationship.
Question 2(a)	Most candidates were able to show the tangential speed of the pig.
Question 2(b)(iii)	Most candidates were able to calculate the angle θ.
Question 3(a)	Most candidates were able to show the moment of inertia of the rotor assembly.
Question 3(b)(i)	Most candidates were able to calculate the angular acceleration of the rotor assembly.
Question 3(b)(ii)	Most candidates were able to calculate the magnitude of the unbalanced torque acting on the rotor assembly.
Question 3(c)(i)	Many candidates were able to show the direction of the initial velocity of a piece of ice.
Question 3(c)(ii)	Many candidates were able to explain why there was no observable change in the angular velocity of the rotor assembly.
Question 3(d)	Most candidates were able to substitute into the given relationship and calculate the maximum power generated.
Question 4(a)	Many candidates were able to calculate the mass of Didymos.
Question 4(b)(i)	Most candidates were able to calculate the escape velocity from Didymos.
Question 5(a)(i)	Most candidates were able to calculate the Schwarzschild radius of the Earth.
Question 5(a)(ii)	Most candidates were able to substitute into the given relationship and calculate the time difference Δt.
Question 5(c)(i)	Many candidates were able to calculate the angular velocity of the torus.
Question 6(a)(i)	Most candidates were able to calculate the power per unit area emitted from the surface of Wolf 359.
Question 6(a)(ii)	Most candidates were able to calculate the radius of Wolf 359.

Question 6(b)(i)	Many candidates were able to state the name of the particles.
Question 7(b)(i)	Most candidates were able to calculate the de Broglie wavelength of the proton.
Question 7(b)(ii)	Many candidates were able to explain why wave-like behaviour is not observed for the proton.
Question 7(c)(i)	Many candidates were able to substitute into the given relationship and determine the scattering angle.
Questions 7(c)(ii)	Many candidates were able to state that the observed Compton shift will decrease and some were able to justify their answer.
Question 8(a)(ii)	Many candidates were able to determine the radius of the helical path.
Question 9(a)	Most candidates were able to determine the compression distance Δy of the spring due to the block.
Question 9(b)(ii)	Most candidates were able to calculate the angular frequency of the oscillation.
Question 10(a)(i)	Most candidates were able to determine the speed of the transverse wave.
Question 10(a)(ii)	Many candidates were able to calculate the amplitude of the wave.
Question 10(a)(iii)	Many candidates were able to explain why there is a maximum distance at which the scorpion can detect the beetle.
Question 10(b)	Many candidates were able to determine the time interval.
Question 11(a)	Many candidates were able to state the correct laser and were able to justify their answer.
Question 11(b)(i)	Most candidates were able to determine the wavelength obtained by the technician.
Question 11(c)(ii)B	Many candidates were able to suggest one disadvantage of moving the screen further away.
Question 12(a)	Many candidates were able to describe an experiment to determine whether the light from a laptop screen is plane polarised. However, some incorrectly included both a polariser and an analyser.
Question 13(a)(ii)	Many candidates were able to calculate the electric field strength.
Question 13(c)(i)	Many candidates were able to determine the maximum work done.

Question 14(b)	Many candidates were able to substitute into the given relationship and determine the maximum magnetic induction produced by the solenoid.
Question 14(c)(ii)	Many candidates were able to suggest a ferromagnetic material.
Question 16(a)(i)	Many candidates were able to state the number of time constants.
Question 16(a)(ii)	Many candidates were able to determine the resistance of resistor R.
Question 16(c)(ii)	Most candidates were able to calculate the reactance of the capacitor.

Project

Abstract	Many candidates clearly stated the aims and findings of their project.
Underlying physics	Many candidates were able to give a reasonable account of the physics behind their project with sufficient depth and at an appropriate level. Some candidates were able to give a good account of the underlying physics.
Procedures	Many candidates scored well in the 'level of demand' section. In many cases the procedures were at an appropriate level for Advanced Higher and indicated 10 to 15 hours of experimental work. Many candidates were able to describe the apparatus and procedures they used in their project.
Results	Many candidates produced raw data that was sufficient and relevant to the aims of their project. Many candidates were able to produce graphs of their data and perform relevant analysis using the gradient. To be able to attain full marks in the analysis section, candidates must perform graphical analysis where possible. Many candidates showed an awareness of scale reading, random and calibration uncertainties. The use of the LINEST function in Excel showed improvement, however, some did not present the raw 'box' data.
Discussion	Many candidates were able to write a conclusion that was valid and related to the aims of their project. Some candidates were awarded the mark for a report that indicated a quality project, which had been carried out competently and was well worked through.

Presentation	Most candidates produced a well-structured report with appropriate title, contents page and page numbers.

Areas that candidates found demanding

Question paper

Question 2(b)(i)	Some candidates were able to label and name the forces acting on the pig. Common issues included arrows for the weight and tension that were some distance from either the pig or the string or the inclusion of incorrect forces.
Question 2(b)(ii)	Some candidates were able to derive the relationship specified in the question.
Question 2(c)	While many candidates were able to state the effect on the angle of the battery running out, only a few could give an appropriate justification for their answer.
Question 4(b)(ii)	Some candidates were able to identify that the gravitational potential energy of Dimorphos would be less. However, only a few could give an appropriate explanation for this change.
Question 4(c)	Few candidates were able to suggest why the impact must occur at a large distance away from the Earth. Candidates incorrectly assumed that the impact caused debris or that the Earth's gravitational field affected the path of the asteroid.
Question 5(b)	Some candidates were able to determine the daily adjustment that must be made to a clock on-board a GPS satellite. Some candidates indicated the incorrect 'direction' of adjustment and others indicated no 'direction' of adjustment.
Question 5(c)(ii)	Some candidates were able to identify which clock would run slower. However, only a few could give an appropriate justification for their answer.
Question 6(b)(ii)	Some candidates were able to suggest why deuterium does not build up in the star due to the p-p chain given in Figure 6A.
Question 6(c)	Few candidates were able to suggest why scientists have not yet observed the fate of a certain class of stars. Candidates incorrectly answered in terms of the speed of light and the lifetime of the scientists.
Question 7(a)	Some candidates could state one piece of experimental evidence for a 'particle' showing wave-like behaviour. Some candidates just gave the

name of an experiment rather than stating what the experimental evidence from the experiment was.

Question 8(a)(i)	Some candidates were able to explain why the proton follows a helical path in the magnetic field. Some candidates talked about horizontal and vertical components, rather than talking about the components of the velocity being parallel or perpendicular to the field.
Question 8(b)(i)	Some candidates were able to identify one change to the helical path followed by the proton. However, few could justify why the path had changed.
Question 9(b)(i)	Some candidates were able to derive the required expression for angular frequency.
Question 9(b)(iii)	Many candidates were able to state that the angular frequency would be greater, but of these candidates, only some could give a suitably complete and correct justification.
Question 9(c)(i)	Some candidates were able to identify the type of damping shown in the graph. Candidates invented many new 'types' of damping beyond the three they should know.
Question 9(c)(ii)	Some candidates could suggest an appropriate change to the damping system.
Question 11(b)(ii)	Few candidates were able to suggest a reason why the wavelength obtained was less. Answers lacked detail and did not identify the direction of change of the measurements.
Question 11(c)(i)	Few candidates were able to explain fully how a series of bright spots was produced on the screen. Answers lacked the sophistication of an Advanced Higher answer and did not include the terms 'in phase' and 'coherent'.
Question 11(c)(ii)(A)	Some candidates were able to suggest an advantage of moving the screen further away. Candidates did better at suggesting a disadvantage in the next part of the question.
Question 13(a)(i)	Only some candidates could state what is meant by electric field strength.
Question 13(b)(i)	Some candidates could determine the magnitude of the resultant electric field due to both charges.
Question 13(b)(ii)	Few candidates were able to state the direction of the resultant electric field strength. The most common incorrect answer was 'down' as opposed to 'down the page'.

Question 13(c)(ii)	Few candidates were able to suggest a reason why the work done would be less than the maximum value.
Question 14(a)	Few candidates were able to sketch the magnetic field pattern produced by the current. Sketches were poorly attempted without due care and attention paid to the parallel field within the solenoid.
Question 14(c)(i)	Few candidates were able to state what is meant by the term 'ferromagnetic'.
Question 14(c)(iii)	Some candidates were able to predict the effect of the insertion of a ferromagnetic material on the magnetic field lines around the solenoid.
Question 16(b)	Some candidates were able to identify that the time taken for the capacitor to fully charge would be equal and justify why that was the case.
Question 16(c)(i)	Only some candidates were able to state what is meant by the term 'capacitive reactance'.
Question 17(a)(i)	Few candidates were able to determine the mean period of the pendulum. Candidates did not realise that the data given was for 10 oscillations.
Question 17(a)(ii)	Many candidates were able to determine the approximate random uncertainty in the mean of the measured times. However, only a few could then go on to determine the absolute uncertainty in the period.
Question 17(b)	Some candidates were able to calculate the gradient of the line and then use that to determine a value for g.
Question 17(c)	Many candidates were able to explain either why the experiment was precise or why it was not accurate. However, only some candidates were able to explain both aspects of the statement.

Project

Underlying physics	Some candidates were unable to demonstrate a good understanding of the physics behind their project. In some cases, relationships were simply stated without any attempt at their derivation. Relationships were frequently stated, but in some cases there was no attempt to define quantities or units. Some candidates attempted to reproduce derivations from textbooks or internet sites but made a number of errors and omissions when doing so.
Procedures	Some candidates did not include labelled diagrams and/or photographs of sufficient clarity. A number of candidates did not describe their procedures using the past tense or include the range and interval of the independent variable.

Results	Some candidates did not include all raw data and so could not access the data mark. Examples include the time for 20 oscillations, the measured dimensions of a ball bearing or capacitor plate and the original length of a wire. Some candidates produced graphs using software packages that were not of a suitable size, did not include minor gridlines or used data points too large to allow for accurate checking of the plotting. Some candidates did not show sufficient working in their examples of analysis. Candidates should be encouraged to show sample calculations. Some candidates showed invalid averaging of calculated or derived values.
Discussion	Some candidates did not evaluate their experimental procedures in sufficient depth or with sufficient sophistication to score well. Some candidates' evaluations were too general in nature and not of an Advanced Higher level; for example, 'the equipment was old and could have been better' or 'the experiment worked well.' Candidates should, for example, identify the dominant source of uncertainty and suggest how this may be reduced. Some candidates also did not evaluate the project as whole and simply repeated statements made in the evaluation of experimental procedures. Again, the language used here was at times superficial; for example, 'the best result was experiment 2'.
Presentation	Although an improvement on previous years, only some candidates listed and cited references to at least three sources of information in either Vancouver or Harvard style.

Section 3: preparing candidates for future assessment

Centres and local authorities are reminded that Advanced Higher Physics is a practical course that requires the development of knowledge, understanding, and skills related to practical work. It also includes a project that requires 10 to 15 hours of individual practical work for each candidate.

While some centres may need to deliver some of the theory online, candidates **must** be given the opportunity to take an active part in a wide range of practical work throughout the course, including opportunities to evaluate and analyse, to develop the necessary knowledge and skills.

It is best to do experimental work at the appropriate point in the course so that it links in with the theory and aids understanding, rather than being seen as a separate, standalone activity.

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. They should also enable candidates to improve their performance in the project.

Question paper

Candidates were, in general, well prepared for the question paper, and showed a good understanding of the majority of the concepts tested.

Questions assessing candidates' ability to select and use relationships to determine values were well done.

Overall, 'show' type questions were done well; however, candidates should be reminded that they must show all steps of the calculation. To gain all the marks, the answer must start with an explicit relationship, show all appropriate substitutions, and state the given final answer, with units. When the answer to a show question is used in subsequent parts of a question, candidates must use the answer given, not an unrounded value they calculated.

Many candidates attempted questions requiring a 'sketch' without due care. Candidates should be encouraged to represent their sketch in a neat manner and as accurately as possible. Candidates should be encouraged to use a ruler, where appropriate. Where force vectors are to be sketched, candidates should be advised that the vectors must be in contact with the object in question.

'Justify' questions were well attempted and many candidates made a good attempt at using physics to explain their answer. However, candidates should be reminded that to gain marks in a 'must justify' question, they must attempt a justification. Candidates should be reminded that many explanations should include what variables have remained constant when explaining why a dependent variable has changed.

In answering numerical questions, candidates should be discouraged from rounding numbers prior to the final answer (intermediate rounding). Candidates should also be strongly discouraged from including a penultimate line to their working, showing an unrounded or truncated final value. A number of candidates rounded incorrectly, or truncated the number, leading to errors in the final answer, resulting in the mark for the final answer not being awarded. The final answer should be rounded to the appropriate number of significant figures and given in decimal form.

Candidates should be given opportunities, either verbally or in writing, to practise explaining concepts and ideas from the course, such as gravitational potential energy, helical motion of charged particles, polarisation, ferromagnetism, and precision and accuracy of experimental measurements.

Open-ended questions from past SQA question papers could provide opportunities for candidates to practise explaining some of the more challenging concepts in the course. However, candidates should be discouraged from simply stating three pieces of information to try to access the 3 marks. Candidates should be encouraged to reference both the text and diagrams in an open-ended question and answer in the context of the question and at a level appropriate to Advanced Higher.

Candidates should be encouraged to take care and use the correct physics terminology when answering questions assessing the knowledge of definitions. While some variation in wording may be acceptable in response to descriptive and explanatory questions, there is less scope for such variation when answering 'State what is meant by ...' questions. For example, most candidates were unable to state what is meant by 'ferromagnetism' and many were unable to state what is meant by 'capacitive reactance'.

Candidates should be encouraged to make their handwriting as clear as possible. This is particularly important when using 'α' in angular motion relationships.

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

Centres should also refer to the Physics: general marking principles document, available on the Advanced Higher Physics subject page, for generic issues related to the marking of question papers. Centres must adopt these general instructions for the marking of prelim examinations and centre-devised assessments for any SQA Physics courses.

Project

Topic choice

Centres are reminded that, unless they are presenting a large number of candidates (more than 10), candidates should not be allowed to choose a topic that may lead to experimental procedures similar to those being carried out by another candidate in the centre. Centres presenting a larger number of candidates must minimise the number of candidates investigating the same topic. There should be no need for candidates in a small class or group to be investigating the same topic. If two candidates in a centre are following the same experimental procedures, the teacher or lecturer must ensure that each candidate carries out research, including experimental work, individually. There should be no situations where a whole class, irrespective of class size, is investigating the same topic. Candidates must work individually and group work is not permitted.

To score well in the project, each candidate should be encouraged to choose a topic for which the underlying physics and experimental procedures present an appropriate level of challenge, and the opportunity to access marks for the introduction, procedures, results and discussion. In particular, the experimental procedures should allow candidates to carry out graphical analysis. The experimental procedures should be at a level commensurate with Advanced Higher.

Abstract

Candidates should state the aim or aims of their project, as well as their findings, clearly. If the aim is to measure a physical constant using a number of procedures, candidates should name or briefly describe each procedure, stating the value obtained for the constant, complete with unit and preferably the uncertainty, for each procedure. If the aim is to compare methods, candidates should be clear which aspects are being compared — for example, accuracy, precision, ease of measurement, number of uncertainties — rather than stating 'method A was better than method B'. If the aim is to confirm a relationship between variables, candidates should be wary of stating that a relationship shows direct proportionality in their findings if the line of best fit does not pass through the origin.

Underlying physics

To attain the marks in this section, candidates should demonstrate a good understanding of the physics of their chosen topic. Simply stating a number of relationships without any derivation, or reproducing information from sources without input from the candidate, would not demonstrate good understanding. Candidates should be encouraged to use referenced diagrams and illustrations in this section. The inclusion of historical, socio-economic or other non-physics information may be of interest, but does not contribute towards demonstrating an understanding of physics, and is likely to be given no credit.

Procedures

Candidates should include clear, uncluttered, labelled photographs or diagrams to help describe the apparatus. Attempts to sketch apparatus electronically using drawing packages usually produced diagrams lacking the clarity necessary for replication. It may have been quicker and clearer to produce a sketch using pencil and paper and scan it into the report. A circuit diagram should support the description of apparatus used in a procedure involving an electrical circuit. Candidates should describe their procedures, using past tense passive voice, in sufficient detail to allow replication. Candidates should be encouraged to include the following details: the number of repeats and the range and interval of the independent variable. The number of experiments will depend on the chosen topic, but the experimental phase of the project normally consists of three or four related experiments. In any event, candidates should be advised to spend approximately 10 to 15 hours in the laboratory obtaining their experimental data.

Results

For data to be considered sufficient, candidates should ensure the number of repeats, and the range and interval of the independent variable, are appropriate for the experiments. Candidates should include all their data in the report, not just mean values. If the volume of raw data is large, it should be included in appendices.

Additional opportunities to practise graphical analysis and the estimation and combination of uncertainties as part of classwork may support appropriate analysis of raw data, including uncertainties.

Candidates should be reminded to include sample calculations for both analysis of data and uncertainties.

Discussion

In their evaluations of experimental procedures, candidates should be encouraged, as appropriate, to comment on the accuracy and precision of their measurements, the adequacy of repeated readings, the adequacy of the range over which variables are altered, the adequacy of control of variables, any limitations of their equipment, the reliability of their methods, and sources of uncertainties.

In their discussion and critical evaluation of the project as a whole, candidates should be encouraged, as appropriate, to comment on the reasons for selection of procedures, problems encountered during planning, modifications to planned procedures, interpretation and significance of findings, suggestions for further improvements, and suggestions for further work.

Presentation

References to at least three sources of information, listed at the end of the report, should also be cited in the report where information is quoted from the sources. Both the listing and citing of references should be in either Vancouver or Harvard style. In addition to the support given in the 'Instructions for candidates' in the Advanced Higher Physics Coursework Assessment Task (available on the Advanced Higher Physics subject page), many internet sites offer guidance and support in referencing in Vancouver or Harvard style.

Maximum word count

The project report should be between 2500 and 4500 words in length — excluding the title page, contents page, tables of data, graphs, diagrams, calculations, references and acknowledgements. It is possible to produce a high-scoring report using considerably fewer words than the maximum permitted.

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.

Every year, we evaluate the performance of our assessments in a fair way, while ensuring standards are maintained so that our qualifications remain credible. To do this, we measure evidence of candidates' knowledge and skills against the national standard.

During the pandemic, we modified National Qualifications course assessments, for example we removed elements of coursework. We kept these modifications in place until the 2022–23 session. The education community agreed that retaining the modifications for longer than this could have a detrimental impact on learning and progression to the next stage of education, employment or training. After discussions with candidates, teachers, lecturers, parents, carers and others, we returned to full course assessment for the 2023–24 session.

SQA's approach to awarding was announced in March 2024 and explained that any impact on candidates completing coursework for the first time, as part of their SQA assessments, would be considered in our grading decisions and incorporated into our well-established grading processes. This provides fairness and safeguards for candidates and helps to provide assurances across the wider education community as we return to established awarding.

Our approach to awarding is broadly aligned to other nations of the UK that have returned to normal grading arrangements.

For full details of the approach, please refer to the National Qualifications 2024 Awarding — Methodology Report.