Course report 2024

Higher Engineering Science

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: 1,245

Number of resulted entries in 2024: 1,395

Statistical information: performance of candidates

Distribution of course awards including minimum mark to achieve each grade

A	Number of candidates	306	Percentage	21.9	Cumulative percentage	21.9	Minimum mark required	112
B	Number of candidates	281	Percentage	20.1	Cumulative percentage	42.1	Minimum mark required	95
C	Number of candidates	281	Percentage	20.1	Cumulative percentage	62.2	Minimum mark required	78
D	Number of candidates	239	Percentage	17.1	Cumulative percentage	79.4	Minimum mark required	61
No award	Number of candidates	288	Percentage	20.6	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 analysis of the question paper showed that it was fair, balanced and accessible, and performed as expected. However, candidates found some questions more challenging than others (for example, questions 7(b)(i); 7(c); 8(b); 8(e);10(a)(ii); and 11(c)).

Candidates performed very well in areas such as digital electronics and structures calculations, but found analogue electronics more demanding. Questions requiring a detailed written response proved to be challenging, and often candidates provided a non-descriptive answer which lacked the detail required to achieve marks at this level.

Some candidates rounded intermediate calculated answers, which made their final answer incorrect. As a result, they did not achieve all the available marks. However, most candidates gave their final answers to the correct number of significant figures. Many candidates consistently used the π button on their calculators, which led them to more accurate final answers.

Assignment

The assignment performed as expected, with only a few areas more challenging than anticipated. Candidates performed exceptionally well when demonstrating the skill of building (simulating or constructing), however, found the skill of evaluating the most demanding in the assignment. This is reflected in the grade boundary decisions.

Section 2: comments on candidate performance

Areas that candidates performed well in

Question paper

Question 1

Candidates demonstrated a very good understanding of how to draw a digital logic circuit from a Boolean expression, and most candidates achieved full marks.

Question 2

Many candidates demonstrated a good understanding of how to calculate the torque acting on the drum, but some candidates did not achieve marks as they did not use the radius of the drum in their calculation.

Question 3

Although this non-concurrent forces question was well attempted by most candidates, a few candidates did not multiply the forces by the distance from the fulcrum. Most candidates showed an understanding of how to calculate uniformly distributed loads (UDLs).

Question 4

Many candidates were awarded full marks and demonstrated a very good understanding of how to calculate the output voltage of the op-amp.

Question 5(a)

Many candidates were able to annotate the ultimate tensile force on the graph provided and gained this mark. However, some did not attempt this question.

Question 5(b)

Many candidates showed a good understanding of how to calculate strain energy and achieved full marks, but a few candidates did not achieve a mark as they did not use the correct units, resulting in an incorrect final answer.

Question 5(c)

Many candidates were able to describe the effect on the specimen when a force of 50N was applied, and achieved the mark. However, a few candidates did not describe how the specimen extended.

Question 5(d)

Many candidates were able to sketch a more brittle material on the graph provided.

Question 6(a)

Some candidates were able to identify the two faults in the program. Some candidates provided ‘if pin 1 = 0 then pwm’ as a fault. However, this was not awarded marks unless the candidate also wrote the command ‘goto main’ after this command.

Question 7(b)(ii)

Many candidates were able to describe how a mechanical engineer applies mathematical skills when designing a pneumatic system.

Question 7(d)

Many candidates had a good understanding of the control of the system and were able to complete a correct, or nearly correct, flow chart.

Question 8(c)

Many candidates were able to gain full marks. However, some candidates did not achieve marks as they did not calculate the voltage drop over the base resistor, which did not allow them to calculate the base current needed to find the collector current.

Question 8(f)(ii)

Many candidates achieved full marks and were able to complete the circuit diagram by drawing an inverting op-amp with correct resistor values.

Question 9(a)

Many candidates were able to calculate the rotational speed of the motor, but some candidates did not achieve marks due to their incorrect intermediate calculations of torque and power, which meant that their final calculated answer was incorrect.

Question 9(c)

Many candidates achieved full marks by calculating the time taken to fill an empty tank. However, some candidates did not achieve marks as they rounded intermediate calculations, which meant that their final calculated answer was not correct for the time taken to fill an empty tank.

Question10(a)(i)

Many candidates showed a good understanding of transistor theory in relation to this question, but a few candidates made errors finding the voltage over the thermistor when calculating the current through the resistor.

Question10(c)

Many candidates were awarded full marks and demonstrated a very good understanding of how to calculate the voltage from the feedback resistor of the op-amp.

Question10(d)

Many candidates demonstrated a good understanding of proportional control and were able to describe how the speed of the motor would change if the gain of the op-amp was increased. However, a few candidates did not attempt this question.

Question10(e)

Many candidates demonstrated a good understanding of concurrent forces and were able to calculate the magnitude and the angle of the force F. However, a few candidates did not attempt this question.

Question11(a)

Many candidates demonstrated a good understanding of how to calculate the magnitude of members AB and AE when analysing node A, but they found it challenging to calculate the magnitude and nature of members BE and BC when analysing node B. Only a few candidates achieved full or nearly full marks.

Question11(b)(i)

Most candidates demonstrated a very good understanding of the logic diagram and were able to complete the truth table correctly. However, some candidates did not achieve a mark because they made an error with the output from the exclusive OR gate.

Question11(b)(ii)

Most candidates demonstrated a very good understanding of how to complete the Boolean equation from the logic circuit provided.

Question11(b)(iii)

Many candidates demonstrated a good understanding of how to draw a NAND equivalent for the circuit provided, and achieved most of the marks.

Assignment

Tasks 1(b) and 1(c)

Most candidates achieved full marks in this section, successfully designing and simulating an electronic circuit.

Task 2(a)

Most of the candidates achieved full marks in this section, successfully simulating an electronic circuit.

Task 3

Most of the candidates achieved full marks in this section, successfully carrying out a structural simulation.

Task 4(a)

Most of the candidates achieved full marks in this section, successfully designing a digital electronic circuit.

Areas that candidates found demanding

Question paper

Question 7(a)

Some candidates were able to identify three faults and how they should be corrected, but many were unable to describe all three faults with an appropriate correction.

Question 7(b)(i)

Some candidates were able to describe at least one example of why pneumatics is a preferred environmental reason to operate the control system over an electronically controlled system, but a few candidates were unable to describe two.

Question 7(c)

Many candidates did not understand how the MOSFET operated in the circuit. Many did not calculate the drop over the solenoid, and therefore were not able to calculate the correct I_{DS} of the circuit that was needed to determine the V_{GS} from the graph provided. Most candidates did not attempt this question.

Question 8(a)

Many candidates found it challenging to manipulate the voltage divider formula V1/V2=R1/R2 to find the value of R1. Only some candidates showed a good understanding of the mathematics skill needed, and a few candidates did not attempt this question.

Question 8(b)

Many candidates found this question challenging, and were not able to provide the purpose of strain gauge B.

Question 8(d)

Some candidates were able to calculate the range of values that would cause the motor to turn. However, many candidates did not understand how to calculate the voltage out from the voltage divider ladder and did not demonstrate an understanding of how the comparator op-amp operates. Many candidates did not attempt this question.

Question 8(e)

A few candidates attempted this question and were able to describe the operation of all the components in the circuit. But many candidates did not give a description of all the components in the circuit and did not achieve all the marks available.

Question 8(f)(i)

Some candidates did not achieve marks, as they rounded intermediate calculations, which meant their final calculated answer was not correct for R_f.

Question 9(b)

Many candidates did not achieve marks, as they rounded intermediate calculations, which meant their final calculated answer was not correct for the diameter of the bolt. Some candidates achieved full marks by calculating a correct final answer for the bolt diameter.

Question 9(d)

Many candidates were unable to calculate the correct area of the tube (member A), and therefore were unable to calculate the correct wall thickness. Some candidates did not achieve marks due to simple arithmetic errors. Some candidates rounded their intermediate calculations on the way to finding the wall thickness of member A, which meant that their final answer was incorrect. Only some candidates demonstrated a good understanding of materials calculations in this question.

Question10(a)(ii)

Many candidates did not demonstrate a good understanding of how to calculate the base current. Only a few candidates gained full marks for this question. A few candidates did not attempt this question.

Question10(b)

Although some candidates attempted this question and they were able to describe why the operation of a two-state control system was not suitable, many candidates were unable to relate to the situation described and therefore did not achieve the marks available.

Question11(c)

Many candidates did not provide the detail required for a Higher-level response, and were unable to describe how an electronic engineer would use specialised knowledge during the design phase of the traffic management system.

Question11(d)

Many candidates did not provide the detail required for a Higher-level response, and were unable to describe how improvements would have a positive social impact.

Assignment

Task 1(e)

Most candidates found this evaluation task demanding, and performance was poor.

Task 2(c)

Most candidates found this evaluation task demanding, and performance was poor.

Task 4(c)

Most candidates found writing a test plan challenging and did not understand the difference between an expected resulted and the test to be carried out.

Section 3: preparing candidates for future assessment

Question paper

The 2025 question paper will have the same format as the 2024 question paper, and will sample the same range of content. Teachers and lecturers must ensure that candidates are prepared in all areas of the Higher Engineering Science course specification so that they can fully respond to the question paper.

Candidates' responses to the MOSFET question this year highlighted that many did not tackle this question in a methodical way. Many candidates did not understand how the MOSFET operated in the circuit. Many were unable to calculate the drop over the solenoid, and therefore were not able to calculate correct I_{DS} of the circuit that was needed to determine the V_{GS} from the graph provided.

Examples of MOSFET calculations questions can be found in past papers and marking instructions on SQA's website.

Assignment

Centres must strictly adhere to the assessment conditions of the assignment as outlined in the course specification and in the assignment documentation.

For session 2024–25, teachers and lecturers should prepare candidates in the areas of evaluation and testing, with a particular focus on the language and detail required for a Higher-level response, to access the marks in these tasks.

Teachers and lecturers should ensure the simulation software that candidates use provides the flexibility required to match what is being asked in the task.

More information and supporting documentation on the full course assessment is available on the Higher Engineering Science subject page. This includes the course specification, past papers (question paper and assignment), specimen assignment and question paper, and previous years' course reports.

Teachers and lecturers should continue to use the published materials on the Understanding Standards website, which contains candidate evidence from past question papers and assignments, with supporting commentary, presentations, and webinar recordings.

Session 2023–24

In session 2024–25 and beyond, SQA is changing the marking method for the Higher Engineering Science assignment. This will not affect the candidates or how they approach the assignment. However, the assignment documentation will be different to past sessions, particularly with regard to instructions for teachers and lecturers. To support teachers, lecturers and candidates, SQA has updated the specimen assignment to reflect this change.

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.