Course Report 2018

Subject	Engineering Science
Level	Higher

This report provides information on the performance of candidates. 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 Post Results Services.

Section 1: comments on the assessment

Summary of the course assessment

Component 1: question paper

Analysis of the question paper showed that it was fair, balanced and accessible. However, a higher than expected number of candidates found the layout and context of question 9 more challenging than was intended.

The level of demand was slightly greater in questions that examined topics that had not previously appeared in the question paper. In addition, questions that required a detailed written response proved to be more challenging.

These aspects were taken into account when setting the grade boundaries at all levels.

Component 2: assignment

All verified centres used one of the six assignments provided on the SQA secure website — meaning that the instruments of assessment used were valid. Most centres verified continued to use either the 'moving bridge' or 'building maintenance' assignments.

Of the centres verified, the majority were assessing correctly to the national standard. Those that were not were lenient in their marking — some by a considerable margin. This indicates that a number of centres are still applying the assessment criteria leniently. Centres are encouraged to use the Understanding Standards materials and commentaries to support their assessment judgements.

Centres are reminded that this component is part of a national assessment. Teachers and lecturers must not give support unless the candidate explicitly requires it. Where they do give guidance, the marks awarded must reflect this.

Centres are reminded that the assignment must be carried out under open-book conditions, but supervised to ensure that the work presented is the candidate's own.

Section 2: comments on candidate performance

Areas in which candidates performed well

Component 1: question paper

Question 1(a) (i)
A large number of candidates showed a very good understanding of the stress/strain graph and performed the necessary calculation well.

Question 1(a) (ii)
Many candidates showed a very good understanding of the stress/strain graph in relation to Young's Modulus, and were able to annotate the graph with what a higher value of Young's Modulus would look like.

Question 2
Candidates showed a very good understanding of the skills and knowledge needed to successfully respond to this question on concurrent forces.

Question 3
A large proportion of candidates answered this question correctly but gave a similar, if not the same, answer twice and therefore lost marks. Calculations of Young's Modulus and Ultimate Tensile Stress were given as two separate skills. Candidates could have given analysing results or simulating material/structural performance using computer software as different skills.

Question 4(a)
A large proportion of candidates showed a good understanding of non-concurrent forces.

Question 4(b)
Most candidates answered this question well but they often stated, rather than described, answers. Candidates need to give a bit more detail *describing* the impact of LED/OLED-based lights.

Question 5(b)
A small proportion of candidates showed a good understanding of MOSFETs. However, evidence shows that candidates from a large number of centres did not fully understand the theory behind the operation of a MOSFET, and a larger than expected number of candidates did not attempt to answer this question. Candidates did not understand that the voltage out from the voltage divider circuit was the Gate voltage of the MOSFET.

Question 6(a)
Candidates attempted the question on drawing a flow chart very well. Most candidates gained at least half marks, with a good proportion gaining most of the marks available. On a few occasions, candidates lost marks because their work was indecipherable.

Question 6(c)
Many candidates showed a very good understanding of Boolean equations, including the 'Exclusive OR', and gained high marks.

Question 6(d)
A significant number of candidates performed well, showing a very good understanding of NAND Equivalents.

Question 7(b)
Although most candidates attempted this question well, a larger than expected number of candidates lost marks because of minor errors such as showing positive feedback on the error detector.

Question 7(d)
A number of candidates showed a good understanding of power/efficiency/torque and demonstrated the skills and knowledge required.

Question 7(e)
As with question 7(d), many candidates performed well. Candidates showed a very good understanding of the skills and knowledge of manipulating and combining given formulae to obtain answers to complete this question.

Question 8(b)
A large number of candidates attempted this question, compared to a similar question in the 2017 question paper. Although it was challenging, the question performed as expected. The course clearly covers this area of content and it has been assessed in a similar way in past years.

Question 8(c) (i)
Candidates showed a very good understanding of the skills and knowledge needed to successfully complete this question.

Question 8(c) (ii)
A large number of candidates performed well. However, a small number of candidates lost marks because they did not carry their answer for stress from 8(c) (i) into this part of the question.

Question 9(a)
A large number of candidates attempted this pneumatic question but could not fully describe how the circuit operated. Understanding of individual components was evident, but a higher than expected number of candidates failed to describe how the piston in the double acting cylinder was slowed down. Candidates must show a clear understanding of this part of the circuit to gain maximum marks.

Question 9(d)
A higher than expected number of candidates did not attempt this question. However, a very high proportion of those who did attempt this question gained maximum marks.

Component 2: assignment

Candidates performed particularly well in the construction/simulation areas of the assignment, as well as the inclusion of code. Candidates also performed relatively well in flowcharts and mechanical system designs.

Areas which candidates found demanding

Component 1: question paper.

Question 1(b)
A very large number of candidates performed poorly on this question. Most were able to recognise the appropriate formula from the data book, but did not change millimetres into metres.

Question 5(a)
A number of candidates found this question very challenging. Candidates were not able to describe how the current through the lamp in circuit B is controlled by the base current of the transistor.

Question 6(b)
Although most candidates attempted this question, it proved to be challenging. Candidates started the question correctly, showing understanding of Uniformly Distributed Loads, but could not recognise that the reaction at B caused an Anti-Clockwise Moment.

Question 7(a)
While a very large number of candidates attempted this question, many did not understand the purpose of a ‘coupling’.

Question 7(c)
More candidates than expected did not attempt this question, and those that did found it challenging. A high proportion of candidates that did respond could not fully explain how proportional control was able to control a steady temperature. Candidates who chose to use an annotated diagram in their response tended to do better than those that did not.

Questions 8(a) (i) and 8a (ii)
A large number of candidates attempted this question. However, a number of candidates provided what was considered to be the same answer twice for both a benefit and a role; at most these candidates could only score half of the available marks.

Question 9(b)
A number of candidates found this question more challenging than was expected. Candidates could not recognise that pressing valves A and B together allowed exhaust air from the cylinder to exhaust more quickly as valves E and D were actuated at the same time.

Question 9(c)
A number of candidates found the context of this question more challenging than expected, and several did not attempt this question. Candidates made errors when using ohms law to calculate current. Errors included incorrect value for voltage where candidates would use 6V or 5.1 volts.

Question 9(e)
A number of candidates found the context of this question more challenging than expected, and several did not attempt this question. Many candidates were not able to read the LDR graph to obtain the required light level.

Question 9(f)
A number of candidates found this question very challenging and were not able to describe, in detail, how the circuit operated. On many occasions, candidates gave a simple statement to answer the question but did not reference key parts of the circuit. For example, they did not refer to how a comparator operates in conjunction with the transistors.

Question 9(g)
A number of candidates found this question very challenging and gave ‘no response’ to the question. Candidates were not able to describe, in detail, how the relays operated in conjunction with each other or how only one solenoid could be actuated at a time. Most candidates who did attempt the question failed to talk about how the size of the input voltages to the transistors affected which transistors were switched on.

Component 2: assignment

Aspects of the assignment where candidates found additional demand were:

Section 1 — analysing the problem
Although no marks are awarded for it, candidates could begin by demonstrating an element of research (for example, for the bridge problem, researching different types of bridges, weight of an average car loaded with people, length and width of an average bridge, factor of safety). This would allow them to detail dimensions, maximum loads and bridge type in the specification. Without this research, candidates will find it challenging to provide a detailed specification.

Candidates should begin the assessable portion by providing a ‘top level’ Universal System Diagram to exemplify the whole system. From this, they should identify the required sub-systems (for Higher level, it should use either two-state or proportional closed-loop control)

and then provide a detailed system specification. This specification should cover all sub-systems identified, in addition to other considerations for the whole system. Detail should reflect the level being assessed.

Section 2b — designing a solution
Any mathematical calculations must be of a level at least of the demand of National 5 (SCQF 5) Mathematics and relate to Higher (SCQF 6) Engineering Science. For structural design, calculations of reaction forces, nodal analysis, factor of safety, stress and strain are expected. Calculations should be detailed and correct for full marks; merely providing calculations of compound gear trains is inappropriate at this level. Again, this was an issue this year. Some centres incorrectly awarded candidates full marks for work more appropriate to National 5 level.

A full-mark design must have both structural and mechanical aspects to ensure that it is 'complete and correct'.

Section 3a — constructing/simulating a solution
Many candidates lost marks for the sub-system integration and justification of materials and components, or wrote a bare minimum by stating a material choice. This is an open-book assessment where candidates have access to reference materials and the internet. Justifications should compare properties and characteristics of a number of materials and components, before arriving at justified decisions. Candidates must give a detailed response to attain full marks, reflecting learning from the Higher course.

Section 4 — testing the solution
An awareness of timing is vital for this section. Prior to the tests, candidates should detail what tests they plan to carry out (including what hardware and software is required, and what they are going to do) and what results they expect to get from each of the tests. The planned tests must cover every sub-system and detail each expected result. After the tests, candidates should detail the actual results of the tests, compare them against the expected results, and detail any amendments made. For full marks, the response should be appropriate to the level being assessed, and should cover all sub-systems.

Section 5 — reporting
As in Section 4, the evaluation should be detailed and well-argued, covering all sub-systems, comparing them with every item in the specification and making recommendations for improvement.

Section 3: advice for the preparation of future candidates

Component 1: question paper

In session 2018-19, the question paper component will increase in length while still sampling the same range of content. Centres must ensure that candidates are prepared in all areas of the course specification so that they can fully respond to the question paper.

Component 2: assignment

This is the final year of the course assignment in its current format. Centres should take particular note of the requirements of the new annually issued and externally assessed assignment.

Grade boundary and statistical information:

Statistical information: update on courses

Number of resulted entries in 2017	1126

Number of resulted entries in 2018	1014

Statistical information: performance of candidates

Distribution of course awards including grade boundaries

Distribution of course awards	Percentage	Cumulative %	Number of candidates	Lowest mark
Maximum mark				
A	22.4%	22.4%	227	103
B	25.4%	47.8%	258	87
C	21.6%	69.4%	219	72
D	11.0%	80.5%	112	64
No award	19.5%	-	198	-

General commentary on grade boundaries

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

SQA aims to set examinations and create marking instructions which allow a competent candidate to score a minimum of 50% of the available marks (the notional C boundary) and a well prepared, very competent candidate to score at least 70% of the available marks (the notional 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 every year for each subject at each level to bring together all the information available (statistical and judgemental). The Principal Assessor and SQA Qualifications Manager meet with the relevant SQA Business Manager and Statistician to discuss the evidence and make decisions. The meetings are chaired by members of SQA's management team.

- Grade boundaries can be adjusted downwards if there is evidence that the exam is more challenging than usual, allowing the pass rate to be unaffected by this circumstance.
- Grade boundaries can be adjusted upwards if there is evidence that the exam is less challenging than usual, allowing the pass rate to be unaffected by this circumstance.
- Where standards are comparable to previous years, similar grade boundaries are maintained.

Grade boundaries from exam papers in the same subject at the same level tend to be marginally different year to year. This is because the particular questions, and the mix of questions, are different. This is also the case for exams set by centres. If SQA alters a boundary, this does not mean that centres should necessarily alter their boundary in the corresponding practice exam paper.