Course Report 2017 – External Assessment

Subject	Engineering Science
Level	Higher

The statistics used in this report have been compiled before the completion of any Post Results Services.

This report provides information on the performance of candidates which it is hoped will be useful to teachers, lecturers and assessors in their preparation of candidates for future assessment. It 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.

Section 1: Comments on the assessment

Component 1: question paper

The total number of candidates sitting the examination has increased from the previous year.

Analysis of the question paper showed that the 2017 exam was fair, balanced and accessible. The assessment was found to function as intended.

A review of performance in the question paper showed that candidates found questions which examined topics which were not covered in question paper from previous years more demanding.

Component 2: assignment

All verified centres used one of the six SQA assignments provided on the secure area of SQA's website — meaning that the instruments of assessment used were valid. Centres should be aware that it is mandatory for centres to use one of the assignments from the current SQA bank for component 2. The majority of centres verified continued to use either the Moving Bridge or Building Maintenance assignments. Centres are reminded to ensure that the most up-to-date assignments are being downloaded and used.

Of the centres verified, most were assessing to national standards. Those that were not were lenient in their marking — some by a considerable margin. This would indicate 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, and the approach used should be one where no teacher support is given unless it is explicitly required by the candidate. In such cases, marks should be deducted to reflect this, and this support should be noted on the marks sheet to justify assessment judgements.

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

Section 2: Comments on candidate performance

Areas in which candidates performed well

Component 1: question paper

Question 1: Candidates showed a good understanding of the effect on the specimen at the two values given, and were able to describe clearly how the specimen behaved after the stress was removed.

Question 2: Many candidates found this question straightforward, but errors were made when changing the angled forces into their horizontal and vertical components. Marks were lost in this area.

Question 3: This question showed that skills and knowledge at National 5 level for a moments question was evident. However, many candidates dealing with the UDL part of the question (Higher skill) either did not know how to use this information or simply did not consider it in the execution of the question. Marks were lost in this area.

Question 5: Candidates were able to describe an economic and social impact of this emerging technology.

Question 7(a)(i): The majority of candidates were able to write the Boolean equation but many did not recognise the EOR gate and simply included an OR gate.

Question 7(a)(ii): Excellent response by candidates completing the truth table.

Question 7(a)(iii): The majority of candidates were able to draw the Nand equivalent for NOT and AND but lost marks for the EOR.

Question 8(a): A number of candidates recognised that an error detector was needed in the control diagram, but a common mistake showed a positive error as opposed to a negative error. Output driver and altimeter was recognised as missing in the control diagram, but a common omission was not including arrows.

Question 8(b): Candidate performance in transistor theory was good and candidates used the formula provided from the data booklet well. However, the final answer V_1 adding the voltage drop over the 1.2kΩ resistor to V_{be} 0.7 V, was missed by a number of candidates.

Question 8(d): The calculation of V_{alt} for the difference amplifier was done well.

Question 9(a)(i)(ii)(iii)(iv): The question on the topic of stress, strain and the factor of safety was well answered. Comments on the appropriateness of the factor of safety (part (iv)) was also answered well by candidates who attempted this question, although a higher than expected number of candidates did not attempt this part of the question.

Question 9(b)(i)(ii)(iii): Candidates answered questions on torque, power and efficiency well.

Question 9(c): Candidates responded to this question well, but marks were lost due to candidates not sketching at least six pulses. Candidates understood that the graph showing PWM could be sketched correctly with a number of different variations of MARK/SPACE ratios to increase the speed.

Question 10(a)(i): Candidates were able to describe the operation of the pneumatic circuit.

Question 10(b): Candidates were able to achieve good marks drawing the required flowchart.

Component 2: assignment

Candidates performed particularly well in the construction/ simulation areas of the assignment as well as the inclusion of code — these are the parts of the assignment where marks are more accessible. Flowcharts and mechanical system designs were also relatively well done.

Areas which candidates found demanding

Question 4: Candidates did not perform as expected in this Ohm's law and Kirchhoff's first law question. Part (c) in particular, appeared to be more challenging. A high number of candidates did not attempt this part of the question.

Question 6: A number of candidates did not show the required knowledge and understanding of MOSFETS. A number of candidates did not attempt this question and basic theory of this component was lacking by many candidates who did attempt it.

Question 7(b): A number of candidates did not describe knowledge and skills of an electronic engineer in the context of the question. Often answers were a general description of an electronic engineer.

Question 7(c): Many candidates did not pick up on economic aspects of the plant being environmentally friendly.

Question 8(c): A number of candidates did not recognise the type of op-amps in the question. Of the candidates that did recognise the type of op-amp, many lost marks when calculating the final answer. A number of candidates did not attempt this question.

Question 8(e): A number of candidates did not understand the operation that the op-amps performed in the circuit. Many written descriptions provided were not of the standard required for Higher. A number of candidates did not attempt this question.

Question 8(f): A higher number of candidates than expected did not attempt this question.

Question 9(d): Nodal analysis. This part of the question was not attempted well, and a number of candidates did not attempt it at all. Nodal analysis is still proving to be a challenging topic in Higher Engineering Science. In many cases candidates did not demonstrate the knowledge and understanding of how they could solve the problem by

using simultaneous equations. The mechanics of tackling this question proved to be difficult **and** showed limited candidate knowledge. The 2016 Course Report (Section 3), advised centres to seek guidance on the use of simultaneous equations when tackling nodal analysis and to refer to the SQA Higher Engineering Science specimen question paper.

Question 10(a)(ii): Candidates found the word 'components' in the question to be confusing, especially when referring to criterion 1. Some candidates replaced the whole of valve 2 rather than the actuator. The marking instructions were applied to accommodate this.

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, etc. This will allow them to detail dimensions, maximum loads, bridge type, etc in the specification. Without this research, candidates will find it challenging to provide a detailed specification.

Candidates should start off 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 (as it is Higher, it should utilise 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 (Higher).

Section 2b — Designing a Solution

Calculations should reflect learning in the Higher course. For structural design, calculations of reaction forces, nodal analysis, factor of safety, stress, strain, etc, would be expected. Calculations should be detailed and correct for full marks. Merely providing calculations of compound gear trains is inappropriate for the level. This was found to be an issue this year. In some centres, candidates were awarded full marks for only providing National 5 level work.

Section 3a — Constructing / Simulating a Solution

Many candidates missed out on the sub-system integration and justification of materials and components marks, 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 material and component properties, and characteristics of a number of materials and components, before arriving at justified decisions. To attain the full 5 marks, a detailed response is required, reflecting the 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, what they are going to do, etc.) and details of what results they expect to get from each of the tests. The planned tests must cover every sub-system (as identified in the specification) 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, this should be a detailed response, appropriate to the level being assessed (Higher) 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

The descriptive and explanation-based questions were challenging for many candidates. Responses often ignored the question **command word** and tended to be just basic generic statements that did not refer to the context of the question.

A number of candidates did not take into consideration the **UDL** in the principle of moments calculation question. An example of a typical UDL question can be seen in the specimen question paper provided by the SQA.

The nodal analysis question demonstrated that a number of candidates did not tackle this question in a methodical way. Candidates made a poor attempt at using simultaneous equations to answer the question. Centres should refer to the specimen question paper provided by the SQA for guidance on Nodal Analysis questions that require the use of **simultaneous equations** to calculate magnitude of members.

Centres should make full use of the Course Assessment Specification to ensure that candidates are prepared for all areas of assessment. An example of where candidates did not seem to be prepared was the recognition of the EXOR and its NAND equivalent.

Component 2: assignment

The assessment is a task with many possibilities available at each stage. As a result, a variety of solutions would be expected within a cohort, with a range of presentation styles and structures. Pre-built models, either to use in the assessment or to exemplify possible solutions, are not permitted. Templates for candidates to use are also not permitted.

Assessors should share the marking guidelines with candidates, and candidates should then structure their solution in any way they see fit. Marks can be awarded for sections, regardless of where they are in the structure of the report.

Whilst it was pleasing to see that the conditions of assessment for coursework were adhered to in the majority of centres, there were a small number of examples where this may not have been the case. Following feedback from teachers, we have strengthened the conditions of assessment criteria for National 5 subjects and will do so for Higher and Advanced Higher. The criteria are published clearly on our website and in course materials and must be adhered to. SQA takes very seriously its obligation to ensure fairness and equity for all candidates in all qualifications through consistent application of assessment conditions and investigates all cases alerted to us where conditions may not have been met.

Grade Boundary and Statistical information:
(Completed by SQA)

Statistical information: update on courses

Number of resulted entries in 2016	1029

Number of resulted entries in 2017	1126

Statistical information: Performance of candidates

Distribution of course awards including grade boundaries

Distribution of course awards	%	Cum. %	Number of candidates	Lowest mark
Maximum Mark -				
A	17.8%	17.8%	200	112
B	28.3%	46.1%	319	96
C	25.2%	71.3%	284	80
D	9.1%	80.4%	102	72
No award	19.6%	-	221	0

General commentary on grade boundaries

- While SQA aims to set examinations and create marking instructions which will 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.

- Each year, SQA therefore holds a grade boundary meeting for each subject at each level where it brings 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 the management team at SQA.

- The 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.

- The 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.

- An exam paper at a particular level in a subject in one year tends to have a marginally different set of grade boundaries from exam papers in that subject at that level in other years. This is because the particular questions, and the mix of questions, are different. This is also the case for exams set in centres. If SQA has already altered a boundary in a particular year in, say, Higher Chemistry, this does not mean that centres should necessarily alter boundaries in their prelim exam in Higher Chemistry. The two are not that closely related, as they do not contain identical questions.

- 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.