Course Report 2016

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

Analysis of the question paper showed that the 2016 exam was fair, balanced and accessible. The full range of marks was awarded in all questions and the assessment was found to function as intended.

A review of performance in the question paper showed that candidates found areas of content that did not feature in the predecessor qualification more demanding (as was the case in the 2015 question paper).

Component 2: assignment

The visiting verification model continues to provide opportunities to engage in supportive, professional dialogue enabling clarity to be given on the understanding of national standards. It has largely been well received by centres.

All verified centres used one of the assignments provided on the secure area of SQA's website — meaning that the instruments of assessment used were valid. Centres are reminded that candidates must be set a current assignment for the assessment of component 2 and that this cannot be adapted or altered in any way.

Additional clarity was provided to support centres in deciding upon consistent assessment judgements. This took the form of a move from band descriptors (where a high level of subjectivity existed) to a more rigorous marks rubric. Again, this has largely been well received by centres.

The majority of centres verified used either the Moving Bridge or Building Maintenance assignments. Of the centres verified, the majority were assessing to national standards. Of those that weren't, most were lenient in their marking – some by a considerable margin. This would indicate that a number of centres still have issues when applying assessment criteria. Centres are encouraged to use the materials and commentaries, which are available through SQA's understanding standards activity, to aid in their assessment judgements.

Section 2: Comments on candidate performance

Areas in which candidates performed well

Component 1: Question paper

Question 1(a): This question was answered well by the majority of candidates. Candidates showed a good understanding of using formula to calculate resistance of the motor.

Question 2: This question was answered well by the majority of candidates. Many candidates found this question straightforward, but errors were made when using Ultimate Compressive opposed to Safe Working Stress.

Question 3: This question was answered well by the majority of candidates. Candidates showed good knowledge and understanding of logic gates.

Question 6 (a): This question was answered reasonably well by the majority of candidates. Candidates were able to describe the operation of the pneumatic circuit. However, a common error was candidates starting the circuit by actuating values F or G as opposed to valves A or B.

Question 6 (b): There was a good general response by candidates but a number of candidates did not attempt this part of the question.

Question 6 (c): The majority of candidates were able to describe skills and knowledge of a Mechanical Engineer. However, a number of candidates described the use of **gears**. This was not in the context of a pneumatic question.

Question 6 (d): The question was well answered by the majority of candidates.

Question 7 (a): The question was well answered by the majority of candidates.

Question 7 (b): This question was answered well by candidates. 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.

Question 8 (a): This question was well answered by the majority of candidates.

Question 8 (b): This question was well answered by the majority of candidates. Overall, candidates showed an understanding of NAND equivalents and gained high marks.

Question 8 (c): This question was well answered by the majority of candidates. Candidates showed a good understanding of torque and the use of T=F x r with the radius being used rather than the diameter.

Question 8 (d): This question was well answered by the majority of candidates. Candidates found it easier to describe the properties of the materials provided, although some failed to describe the properties of materials in relation to each other.

Question 8 (e): This question was well answered by the majority candidates. Candidates were able to calculate the load by working through formula in an appropriate and correct sequence of steps.

Question 9 (a): This question was well answered by the majority candidates.

Question 9 (b): This question was well answered by the majority candidates.

Question 9 (d): The question was well answered by the majority of candidates.

Component 2: assignment

Candidates performed particularly well in the construction/simulation areas of the assignment as well as the inclusion of code.

Flowcharts and mechanical system designs were also relatively well done.

Areas which candidates found demanding

Component 1: question paper

Question 1 (b): Candidates performed below expectations for this part of question 1. Candidates lost marks as they did not use the correct total resistance. A number of candidates did not attempt the question.

Question 1 (c): Candidates performed below expectations for this part of question 1. Candidates often used the incorrect formula with the incorrect value. A number of candidates did not attempt this question.

Question 4: Candidates performed below expectations for this question. The response to this question shows that candidates have the skills and knowledge required at National 5 level for a moments question. However, many candidates dealing with the Uniformly Distributed Load (UDL, new to Higher) part of the question either did not know how to use this information or simply did not consider it in the execution of the question.

Question 5: Candidates performed below expectations for this question. A number of candidates failed to provide an explanation of the function of a bearing and a few were only able to provide one function. Candidates should note that the command word **explain** was looking for a cause and effect response.

Question 6(c): A minority of candidates performed below expectations for this question. It should be noted that a number of candidates described an engineer that would not necessarily be involved with the bridge project as specified.

Question 7(c): A number of candidates performed below expectations for this part of the question. A number of candidates failed to describe the knowledge and skills of an electrical engineer in the context of the question. Often answers were a general description of an electrical engineer.

Question 8 (f): A number of candidates performed below expectations for this part of the question. Candidates found it difficult to distinguish between mineral based and oil based lubricants (and a lot of assumptions were made), therefore marks were lost.

Question 9 (c): A number of candidates performed below expectations for this part of the question. Candidates calculated the required values, ie ratio of feedback (RF) and input resisters (Ri) but did not fully complete an accurate sketch of the required op-amps.

Question 9 (e): **Nodal analysis**: A number of candidates performed below expectations for this part of the question and only a small proportion scored full marks. Candidates failed to start the question at the easier node (NODE A) and found the mechanics of tackling this question

difficult or showed limited knowledge. NODE B was poorly analysed by the majority of candidates.

Component 2: assignment

Section 1: Analysing the Problem

Candidates should start off 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 and Strain would be expected. Calculations should be detailed and correct in order for candidates to be awarded full marks. Merely providing calculations of compound gear trains is inappropriate for Higher level (these are in the National 5 course).

Section 3a: Constructing / Simulating a Solution

Many candidates missed out 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. In order to attain full marks, a detailed response is required — again, reflecting on 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 detail 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 the actual results against the expected results, and detail any amendments made. Again, for full marks, this should be a detailed response — appropriate to the level being assessed and should cover all sub-systems.

Section 5: Reporting

Similar to 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 problematic for many candidates. Responses often ignored the question **command word** and tended to be basic, generic statements that did not refer to the context of the question.

A significant number of candidates did not take into consideration the UDL in the principle of moments question.

The Nodal analysis question showed that a high number of candidates failed to tackle this question in a methodical way, and the analysis of Node B by many candidates was not attempted. Centres should refer to the specimen question paper provided by the SQA for guidance on Nodal Analysis. Furthermore, questions that require the use of simultaneous equations to calculate magnitude of members can also be found in the SQA specimen question paper.

The design type questions, ie question 9b, where candidates needed to provide a sketch along with relevant values, would not have featured in the predecessor qualification. Centres are advised to review the content in this area to adequately prepare subsequent candidates as many candidates were unable to provide an answer that combined correct values along with correct sketches.

Component 2: assignment

As mentioned in Section 1, verification experience and statistical analysis suggests that centres are marking Component 2 too leniently.

There is also concern over the support that candidates are receiving as they progress through the assessment. **Please note** 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, the marks awarded should reflect this assistance, and this support should be noted on the marks sheet to justify assessment judgements. This assessment is open-book in nature and should be conducted in controlled conditions.

The assessment is a design task, with many possibilities 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 with candidates the marking guidelines and candidates should then structure **their** solution in any way they see fit.

Grade Boundary and Statistical information:

Statistical information: update on Courses

Number of resulted entries in 2015	881

Number of resulted entries in 2016	1029

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	21.9%	21.9%	225	112
B	27.1%	49.0%	279	97
C	25.4%	74.3%	261	82
D	9.7%	84.1%	100	74
No award	15.9%	-	164	0

Decision Making Record Statement:

The overall demand of the course assessment was lower than intended and so all grade boundaries were set higher than intended.

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.