# Course Report 2019

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| Subject | Engineering Science |
| Level | Higher |

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. 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

## Question paper

The analysis of and feedback on the question paper showed that it was fair, balanced and accessible. However, question 4 was more demanding than intended as a number of candidates misinterpreted the exemplar response (intended to direct their answers) and looked for faults in the Pbasic and Arduino code, rather than one or the other. Grade boundaries were adjusted to reflect this.

While candidates performed well in areas such as materials, calculations, and questions requiring an understanding of flowcharts; they found questions requiring a detailed written response to be challenging.

## Assignment

The structure of the assignment followed that of the specimen coursework assessment task. It performed as intended, and all marks were accessible.

Centres gave positive feedback about the assignment and this was reflected in the evidence submitted by candidates.

# Section 2: comments on candidate performance

## Areas in which candidates performed well

### Question paper

Question1(a)
A very good understanding of the NAND equivalent for the given circuit.

Question 1(b)
A good understanding of why an engineer would choose to use a NAND equivalent circuit.

Question 2(a)
A very good understanding of the knowledge and skills needed to calculate the output voltage of the op-amp.

Question 2(b)
A good understanding of the knowledge needed to describe how to increase the gain of the op-amp.

Question 2(c)
Candidates demonstrated a good knowledge of the op-amp needed to perform the required task.

Question 5
A very good understanding of the knowledge and skills needed to successfully complete this question on concurrent forces.

Question 6
A good understanding of the knowledge and skills needed to successfully complete this question on the control diagram.

Question 7(a)
Although this question was well attempted by candidates, marks were lost due to simple arithmetic errors.

Question 7(b)
Although many candidates showed their knowledge of how to tackle this question, marks were lost by several candidates because they did not consider the number of motors on the plane; therefore the correct power value was not used in calculating time.

Question 7(c)
Although this question was well attempted by candidates, marks were lost by candidates who did not not provide a cause and effect in this explain question.

Question 7(d)
Candidates made a good attempt at this question, but a number of candidates lost marks due to arithmetic errors.

Question 7(e)
Although this question was well attempted by candidates, marks were lost by candidates who did not provide a cause and effect in this explain question. Candidates often gave a reason why friction needed to be minimised but did not explain the effect associated with the reason.

Question 7(f)
Candidates from a large number of centres performed well in this question. However, a number of candidates did not gain full marks — most commonly because they did not calculate the inverting amplifier input correctly (which, in turn, did not allow them to correctly calculate $R_f$).

Question 8(a), (b)(i), (b)(ii)
While a number of candidates did not attempt these questions, those that did performed well.

Question 9(a)(i)
A good understanding of material properties.

Question 9(a)(ii)
A good demonstration of the skill in referencing the data book with knowledge gained from the stress/strain graph.

Question 10(a)(i)
A good understanding of material calculations.

Question 10(a)(ii)
A good understanding of materials and of factor of safety.

Question 10(a)(iii)
A good understanding of the skills and knowledge of manipulating formula to successfully complete the question.

Question 10(b)(i)
A good understanding of the principle of moments.

Question 11(a)
A good understanding of Boolean equations.

Question 11(b)
A good understanding of flowcharts.

Question 12(a)
A good understanding of the operation of the pneumatic circuit.

Question 12(b)
Interpreting the graph was done well, as was the manipulation of formulae to successfully complete the question.

### Assignment

Task 1
The majority of candidates demonstrated very good skills in design and testing of a logic circuit.

Task 2
Candidates performed well in the construction/simulation of the given circuits.

Task 3(a)
Candidates attempted the design of a pneumatic circuit well. Most answered using a hybrid of pneumatic symbols and block diagrams. Some candidates presented responses which were well constructed.

Task 5
Candidates demonstrated very good skills in construction/simulation of the integrated circuit and flowchart.

## Areas which candidates found demanding

### Question paper

Question 4
A number of candidates did not have the Pbasic or Arduino knowledge and skills to answer this question, and several did not attempt the question. Advice was given in the 2018 course report (and webinar) that candidates could be asked to answer this type of question.

Question 8(c)
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 only described the middle stage of the circuit operation. They were also vague about the input voltages they were referencing, whereas candidates that were successful could demonstrate the relationship between $V_{speed}$ and the op-amp saturating.

Question 8(d)
A number of candidates found this question very challenging and evidence showed that they did not have an understanding of the control circuit.

Question 9(b)
A number of candidates found this question very challenging and evidence showed that candidates did not have the necessary skills and knowledge to attempt the entire question. A large number of candidates were able to gain marks from calculating the magnitude of the forces in members AB and AC only.

Question 10(b)(ii)
A number of candidates found this question demanding and it was clear that they did not have an understanding of the equations of equilibrium.

Question 12(c)
A number of candidates did not provide an appropriate Higher level response. Candidates often provided answers that were not descriptive and were not in the context of ‘Drive Systems’.

Question 12(d)
Several candidates found this question challenging and were unable to calculate the final motor speed.

Question 12(e)
Many candidates found this question challenging and were unable to calculate the value of the MOSFET drain current. Very few candidates demonstrated the understanding that the resistance of the motor was important to the question.

## Assignment

Task 2(d)
Some candidates made reference to the first part of the circuit which was tested in 2(b) instead of only referencing the circuit from 2(c).

Task 2(e)
A number of candidates gave descriptive answers instead of evaluative comments relating to the specification.

Task 5(d)
A number of candidates gave descriptive answers instead of evaluative comments relating to the specification.

# Section 3: preparing candidates for future assessment

## Question paper

The question paper requires candidates to draw on and apply knowledge and understanding of a sample of all the concepts listed in the Higher course specification. Centres should ensure that candidates are prepared in all areas of the course specification and should be aware that candidates can be assessed on:

- The function of all the named op-amp configurations and calculations of relationships between input and output voltages for different op-amp configurations.
- Manipulating and combining given formulae to obtain answers, solving structural problems using trigonometric functions, and substitution in simultaneous equations.
- The use of high-level programs to monitor inputs and initiate digital outputs and using high-level programs to make decisions using arithmetic and logic functions.

Centres must prepare candidates to use high-level computer language such as Pbasic or Arduino. In past years questions have been in the form of drawing or completing flowcharts, however candidates could be asked to explain, with reference to a given code, how a system is controlled.

It is clear that a number of candidates have not understood the meaning of the command words (such as describe or explain) in a question and therefore have lost marks. Likewise, candidates must give Higher level responses to gain marks in a Higher level question paper (such as communicating engineering concepts clearly and concisely using appropriate terminology).

It is also clear that many candidates are finding nodal analysis (when used to calculate the size and nature of forces in frames) very challenging. This is an area of content that is integral to engineering science (and is frequently sampled) and candidates must be suitably prepared.

## Assignment

The majority of candidates appeared to be well prepared for the assignment with very few instances of tasks not being attempted.

When submitting photographs (for example, of construction), the images must be clear and of an appropriate size (so that markers can read them and award marks).

Centres must strictly adhere to the assessment conditions of the assignment as outlined in the course specification and in the assignment documentation. Failure to do so could leave the centre open to investigation of malpractice.

Centres only need to submit pages of work that include candidate responses. Each page should only have one task on it and be single-sided, not stapled or glued, and submitted in task order. Each page must have the candidate’s details on the back. Each submission must also have a completed flyleaf at the front.

For tasks such as Task 3(a) when answering using a block diagram approach, each component must be fully labelled. When constructing a pneumatic circuit, labels must be used when components are not identifiable, and piping must be clear. When using simulation software, components must be labelled when standard symbols are not used.

# Grade boundary and statistical information:

## Statistical information: update on courses

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| **Number of resulted entries in 2018** | 1014 |

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| **Number of resulted entries in 2019** | 1110 |

## 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 | 26.7% | 26.7% | 296 | 111 |
| B | 18.9% | 45.6% | 210 | 95 |
| C | 19.7% | 65.3% | 219 | 79 |
| D | 18.4% | 83.7% | 204 | 63 |
| No award | 16.3% | - | 181 | - |

## 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 that allow:

- a competent candidate to score a minimum of 50% of the available marks (the notional C boundary)
- 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 head of service and statistician to discuss the evidence and make decisions. Members of the SQA management team chair these meetings. SQA can adjust the grade boundaries as a result of the meetings. This allows the pass rate to be unaffected in circumstances where there is evidence that the question paper has been more, or less, challenging than usual.

- The grade boundaries can be adjusted downwards if there is evidence that the question paper is more challenging than usual.
- The grade boundaries can be adjusted upwards if there is evidence that the exam is less challenging than usual.
- Where standards are comparable to previous years, similar grade boundaries are maintained.

Grade boundaries from question 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 question papers set by centres. If SQA alters a boundary, this does not mean that centres should necessarily alter their boundary in the question papers that they set themselves.