Course Report 2018

Subject	Mathematics of Mechanics
Level	Advanced 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

Mathematics of Mechanics question paper consisted of 17 questions covering all units appropriately. The first eight questions were designed to allow candidates to show their knowledge of skills and understanding of course concepts, with the remaining questions including a greater degree of reasoning and the more complex topics. The last question was shorter than in previous years and tested one topic that had not appeared in recent papers. Most candidates attempted all questions.

This question paper largely performed as expected. It was very slightly more demanding than the 2017 question paper and this was taken into account when setting grade boundaries.

Section 2: comments on candidate performance

Areas in which candidates performed well

Component 1: question paper

Question 1: motion under constant acceleration

Question 2: partial fractions with integration

Question 3: frictional surface movement and conservation of linear momentum

Question 4: integration of an exponential function requiring application of chain rule

Question 6: volume of revolution

Question 9 (a) proof of an equation of vertical motion and its application in projectile motion

Question 11: relative motion and the consideration of collision

Question 16 (a): sketching a speed–time graph

Areas which candidates found demanding

Component 1: question paper

Question 5	**Motion in a horizontal circle** While many candidates completed this question succinctly, others were unaware of the forces acting and their direction in this situation. Carefully drawing a diagram helps candidates to achieve an accurate solution.
Question 8	**Parametric differentiation** Candidates could apply the required skill, but carelessness in differentiation led to many mistakes. Also, some candidates did not know how to use this process to calculate speed.
Question 10	**Centre of mass** This is still relatively new content. However, we expected candidates to show more accuracy in finding areas and the coordinates of their centres of mass. We recommend using a table to set this type of answer out as it can help candidates to avoid mistakes when processing their final answer. Question 10(b) was particularly disappointing as a similar question is included in the specimen question paper.
Question 12(b)	**Motion in a vertical circle** Question 12 included two tasks, and perhaps this was why question 12(b) was poorly attempted. For motion in a vertical circle, the method

of solution is standard and one that all well-prepared candidates should be confident with.

Question 14 **Elastic potential energy**

Too many candidates seemed unaware of the elastic potential energy stored in a stretched cord. This topic is not frequently examined, but the topic is integral to the course.

Question 15 **Solution of a second order differential equation**

This required candidates to cope with a repeated root and an equation with x and t as variables. Some candidates assumed from the diagram that this question needed the techniques of Simple Harmonic Motion. They did not realise this was an in-context question on differential equations.

Question 16(b) **Working with time dependant graphs**

The reasoning in this part of the question proved too difficult for some candidates. However, those who attempted to answer it were able to gain some marks.

Question 17 **First order differential equation in context**

The mention of 'impulse' in this question seemed to cause difficulty for candidates. Many candidates who managed to set up an equation, struggled with the algebra and calculus needed for the solution.

Section 3: advice for the preparation of future candidates

Component 1: question paper

- Candidates were generally well prepared for the question paper and it was pleasing to see solutions were well presented. Candidates could make greater use of annotated diagrams in their solutions to make the processes more obvious and to avoid careless mistakes.

- Teachers and lecturers should support candidates in revising the techniques and routines outlined in the Course and Unit Support Notes to ensure familiarity and understanding. This allows candidates to start questions confidently. Questions might then demand candidates to apply a further degree of reasoning to find the solution.

- Candidates should make use of Understanding Standards material available online as well as past papers and the specimen question paper. Every candidate should make use of the Analysis Grid for each past paper and use this to make sure they are aware of all the skills needed in this course. All skills will not be assessed in any one year, but they are all covered over several years' papers.

- When teaching calculus, teachers and lecturers should make candidates aware of its applications, especially in mechanics (see comment about question 15 above). For example: parametric differentiation as defining motion in a plane; implicit differentiation; second order differential equations where the variables are of displacement and time and so have application to velocity and acceleration; and the use of new calculus techniques in contexts such as finding centres of mass or volumes of revolutions. Question papers always include skill-based questions, but candidates should be open to applying some of these skills in other contexts.

- Candidates should be vigilant with rounding in all situations. The front of the question paper states 'any rounded answer should be accurate to three significant figures (One decimal place for angles in degrees)'. Marking instructions indicate acceptable answers where candidates round correctly but at the early part of a solution with follow through. In general, candidates should avoid rounding early.

Grade boundary and statistical information:

Statistical information: update on courses

Number of resulted entries in 2017	272

Number of resulted entries in 2018	304

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	50.0%	50.0%	152	69
B	15.5%	65.5%	47	59
C	14.5%	79.9%	44	50
D	4.6%	84.5%	14	45
No award	15.5%	-	47	-

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 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.

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.