Course Report 2017

Subject	Mathematics of Mechanics
Level	Advanced 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

Summary of the course assessment

The question paper consists of written response questions, with a maximum possible mark of 100.

The assessment proved to be very accessible for most candidates, allowing many to achieve well. Candidates were also able to show their understanding of topics and their skill in the application of appropriate methods of solution.

As last year, *stating assumptions* needs greater rigour. Candidates were able to explain why Simple Harmonic Motion was not maintained (Question 12(c)), but defining **i** and **j** vectors in context in Question 14(a)(i) often proved challenging. All candidates are fairly confident working with vectors, but it is vital they understand what these are representing in a particular situation. We will continue to find opportunities to test understanding of contextual use of mathematical methods.

It was evident that most candidates were able to attempt all questions within the three hours allocated, and have some time to check through their work. Most candidates were able to identify what was required in solutions, and to gain marks in all questions.

The questions asked in this paper gave a very balanced mark allocation from each unit. We will always have mark allocation within the prescribed parameters, but candidates should not expect exactly one third of the marks to come from each unit.

Section 2: Comments on candidate performance

Areas in which candidates performed well

Candidates performed well in questions 1; 2; 3; 4; 5; 7; 8; 10; 11; 13; 14(a)(ii) and 17(a).

Question 2; 5; 10; 11:	Tested various algebra and calculus skills and solutions were accurate and competent.
Question 4:	Tested understanding of moments of forces acting on a beam, and was our first testing of this new content. Solutions were very pleasing, particularly in presentation.
Question 7:	Allowed candidates to show their knowledge of projectile motion and was well attempted.
Question 13:	Testing satellite motion produced excellent solutions. Historically questions on this topic have proved challenging so it was very encouraging to have so many competent solutions this time.
Question 14(a)(ii):	Allowed candidates to show their understanding of relative motion and allowed most to score some marks in this question. Many continued accurately with the remainder of the question,

	while others made careless mistakes which made completion impossible.
Question 17(a):	Required candidates to show understanding of motion down a slope, with weight and friction to be considered, and allowed many to gain 5 marks on the last question.

Areas which candidates found demanding

Candidates found questions 6; 9; 12; 14(b); 16 and 17(b) demanding.

Question 6:	Motion in a horizontal circle requires the candidate to be confident in knowing how forces are acting. The common mistake here was in a diagram suggesting balanced forces horizontally, where the frictional force was marked as opposing the normal reaction. Marking the normal reaction as away from the centre of the circle was often suggested in a diagram. It should be noted that comment was made last year on the poor understanding of motion in a horizontal circle when the question was about a banked track.
Question 9:	Questions involving variable force historically are poorly attempted by some candidates. This question involved the work done on a body by a variable force, and it is disappointing to see little improvement in the attempts at solutions of such questions.
Question 12:	Proving simple harmonic motion requires the introduction of a variable to access the proof. The requirement for this proof is specified in the Course Assessment Specification and so it is disappointing to see candidates struggle with it.
Question 14(b):	This question needed accurate algebraic manipulation. When mistakes were made, completing a solution was very difficult, though candidates could gain 2 of the 5 marks.
Question 16:	This question involved the use of an integrating factor. Many candidates did not identify this, meaning they could gain no marks.
Question 17(b):	Adding a horizontal force to a body moving down a slope should be easily recognised by candidates. It requires accurate resolution of this force along and perpendicular to the slope, and the resulting algebra can be challenging.

Section 3: Advice for the preparation of future candidates

It is very pleasing to see that nearly all candidates were confident enough to attempt all questions in the paper, gaining marks in most questions. Presentation of solutions was again very good, allowing candidates to maximise their marks in each question.

Areas where candidates encountered difficulty have been mentioned above and should be highlighted to candidates.

Motion in a vertical circle is another topic of difficulty, as is integration by substitution from Mathematical Techniques for Mechanics. We would continue to encourage candidates to consider assumptions made in a question. As specified in the Course Assessment Specification, candidates must be able to communicate identified strategies of solution and provide justification for the resulting conclusions.

When teaching maths skills of Calculus, you should always make sure candidates are aware of the application of the skill. This is particularly true of 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. Future papers will always include skills-based questions, but candidates should be open to applying these skills in other contexts.

Grade Boundary and Statistical information:

Statistical information: update on Courses

Number of resulted entries in 2016	222

Number of resulted entries in 2017	272

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	53.7%	53.7%	146	70
B	12.9%	66.5%	35	60
C	12.5%	79.0%	34	50
D	3.3%	82.4%	9	45
No award	17.6%	-	48	-

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.