External Assessment Report 2012

Subject(s)	**Applied Mathematics**
Level(s)	**Advanced Higher**

The statistics used in this report are pre-appeal.

This report provides information on the performance of candidates which it is hoped will be useful to teachers/lecturers in their preparation of candidates for future examinations. 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 question papers and marking instructions for the examination.

Comments on candidate performance

General comments

The majority of candidates seemed well prepared. A few candidates, however, did perform very badly in section A of the paper.

Areas in which candidates performed well

Please refer to the question-by-question comments which appear later.

Areas which candidates found demanding

Please refer to the question-by-question comments which appear later.

Advice to centres for preparation of future candidates

General

There were some very well presented scripts. However, in the Mechanics paper, Markers reported some very badly written work and some working which gave no clear indication as to what approach was being used. Candidates may, therefore, have lost the opportunity of being awarded all the marks which should have been available to them due to poor presentation of their answers.

Here are question-by-question comments in the order: Mechanics; Statistics; Section B.

Mechanics

A1 The process for working with motion in a horizontal circle was well known and most students were alert to the need to change units.

A2 This question was poorly attempted. Too many candidates relied on stating the equation of trajectory with some attempt at substitution but few used the parameters of greatest height when time was half the time for the range of the motion. A neat solution was found if the formula

$$s = \frac{(u+v)t}{2}$$

was used but very few candidates tried this. Any other solution depended on using two different formulae with appropriate substitution followed by algebraic manipulation.

A3 Velocity/time graphs questions are easily recognised and most candidates coped well with variable acceleration and the need for calculus in this question.

A4 This question on equilibrium held by string and spring was very well done but candidates should be careful to answer the actual question asked.

A5 This question could be answered using Newton's laws or work/energy principles. It was generally well done although many ignored either the effect of the weight of the train or that of friction.

A6 Gravitation questions need great care to be taken with units. Candidates knew how to start this question but relatively few completed the solution. It must be emphasised that the only stated constant that can be used in this paper is $g = 9.8\ \text{ms}^{-2}$.

A7 This question used conservation of energy to tackle the initial stages. Many candidates started well but poor algebraic manipulation of square roots led to problems. Conservation of momentum completed the solution and here many candidates ignored the direction of motion after impact.

A8 Variable velocity and acceleration was well recognised although some misinterpretation of given facts was obvious in solutions. Finding the closest distance in relative motion was well attempted but knowing the vector condition for perpendicular motion was more challenging.

A9 As an extended question, most candidates gained marks in this, being able to prove part (a) and able to start the remainder of the question. Solving a differential equation using partial fractions led to many mistakes.

A10 Very few candidates were able to prove the SHM equation for the conical pendulum but it was pleasing to see that most candidates persevered with the rest of the question and were able to gain marks in this.

Statistics

In general, there was an improvement in candidates' ability to state hypothesis and conclusions.

Candidates should be encouraged to state assumptions more clearly. Candidates show an awareness of the standard assumptions for the whole Course but sometimes fail to identify the relevant assumptions for a given situation.

In some questions, candidates did not provide a sufficiently rigorous explanation or proof.

Section A

A1 Many candidates have difficulty in applying the formula for Bayes' Theorem to obtain a correct answer. Tree diagrams are popular and were better displayed this year but many were not adequately annotated with probabilities so that obtaining the correct solution becomes very difficult.

A2 Types of sampling, which is standard knowledge, were not well known. Assumptions were not stated clearly. Comments on the confidence interval indicated that many candidates had some understanding of the link between the CI and the statement but comments such as 'this shows that the statement is true' demonstrates a lack of full understanding.

A3 Some candidates provided assumptions which were too vague. There was some confusion here between V(8X) and $V(X_1)+V(X_2)+ \ldots\ldots +V(X_8)$, the former being 8 times greater than the latter.

A4 This question was generally well done except for some vague responses to the effect on the conclusion. It is incorrect here to use a sign test as we are concerned with ***mean*** fill volume. A few candidates gave conclusions such as 'the mean does not differ from 500.30 ml'.

A5 Many candidates had difficulty with the algebraic manipulation. Many did not provide sufficient detail in the possible advice offered.

A6 Many candidates had little or no knowledge about the limitations on expected frequencies and why categories sometimes have to be combined. Candidates are expected to use the tables for the chi-squared (and *t*) test and not p-values from an advanced calculator. Many candidates did not appreciate the connection between the Poisson distribution and randomness of occurrence of events.

A7 This was generally well done except for the last part. Many candidates wrote down anything they knew about bivariate analysis without thinking about the context of the question. Some candidates suggested drawing a scatterplot which had already been done according to the opening paragraph.

A8 Part (b) required much more careful explanation than most candidates were able to offer; for example for the use of 0.0228, the binomial distribution or the x2.

A9 Mann-Whitney test was well presented except for the few who did not employ a continuity correction and others who did not seem to be aware of how to deal with sample sizes outwith the tables, knowledge which they should have employed during their investigation. There were some vague explanations for the last part and such statements as 'the study shows that drinking water before food aids weight loss'.

Section B

On the whole, candidates seemed well prepared for this section. Both the routine questions and the more demanding questions were tackled well.

B1 This caused some problems as many candidates seemed not to understand what was needed for the general term. A lot worked out the full expansion and then selected the coefficient. This would not have gained full marks.

B2(a) Most were able to use the quotient rule to obtain a formula for dy/dx and then make the necessary substitution to get the gradient.

B2(b) This was mainly done without any problem. Some candidates forgot the minus sign or the fraction $\frac{1}{2}$.

B3(a) A few squared each element but most got this part correct.

B3(b) There were some problems in following the methods used and, in some cases, there were arithmetic errors.

B3(c) Most of those who attempted this part were successful.

B4 Most were able to work out the partial fractions successfully. Marks were lost by candidates not knowing the formula for the volume or making errors in the calculation.

B5(a) This part was usually done well by solving the given equation.

B5(b) Most candidates were able to use the result from (a) to obtain the value of k.

B5(c) This part was more of a challenge but many were successful in getting to the correct answer.

Statistical information: update on Courses

Number of resulted entries in 2011	279
Number of resulted entries in 2012	341

Statistical information: performance of candidates

Distribution of Course awards including grade boundaries

Distribution of Course awards	%	Cum. %	Number of candidates	Lowest mark
Maximum Mark 100				
A	37.2%	37.2%	127	71
B	16.7%	54.0%	57	59
C	20.8%	74.8%	71	47
D	8.5%	83.3%	29	41
No award	16.7%	100.0%	57	-

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.