

### Coursework Report, Summer 2006

We felt that Centres had administered the coursework process effectively this session except for the continued failure to provide the Centre Authentication Form CCS160. Some Examination Officers seemed to have been unaware of the letter sent by the Board to say that grades for the unit would not be awarded without it.

Many Centres change from option A to option B without informing the moderator. Centres are reminded that once the paperwork has been completed by the Board, the moderator will be expecting to receive coursework and should be told of the change.

#### Core, C3 -4753

Moderation was straightforward, the proportion of changes reduced from 29% to 22%.

Common problems continue to occur. Clearly they will continue to do so with different candidates - our concern is that assessors continue to credit work that does not meet the criteria of the investigation.

The most common problem encountered this session was inadequate graphical illustrations. They need to agree with calculated iterates and have both annotation and explanation. Autograph outputs particularly need annotating to be convincing.

#### C of S

The main problems here were that candidates do not give iterates to demonstrate failure and the use of trivial equations.

There continue to be several instances where  $f(x) = 0$  is shown in the table for failure. The method has found the root and so this cannot be counted as a failure and so should not be credited.

#### Newton-Raphson method

The main problem in this domain is the failure to establish and justify error bounds.

#### Rearrangement method

The main problem in this domain is that the rearrangement formula was not stated, particularly with the demonstration of failure. The comparison of  $g'(x)$  and the gradient of  $y = x$  is also inadequate.

#### Comparison of methods

Often the descriptions here are not precise enough. Candidates also use different starting values.

#### Written Communication

The allocation or not of this mark has been more consistent this time. We still find, however, a comment on the cover sheet such as "excellent in every respect" and the mark is awarded only to turn the page to discover that the candidate is going to solve the equation  $x^3 + x - 7$ .

#### Differential Equations - 4758

The number of Centres which required their marks changing is higher than usual (30% compared to about 20%). This could be due to the fact that the students may not have had the experience of modelling in Mechanics 2.

The most common investigations were 'Aeroplane Landing' and 'Cascades'. For the former the weak areas tended to be, in domain 2, not considering the initial model for the whole motion (ie resistance proportional to  $V + B$ ). The source of the data was not always clear, and for full marks in this particular domain, it is expected that the source be made clear, the data given in table and graph form, with a discussion of its accuracy together with the point where the motion changes. In scheme A, in general, candidates often do not address the variation of parameters; this affected marks in two domains.

Since the object of the coursework is to test the student's understanding of the modelling cycle, the role of the assumptions is crucial. Consequently supplying a list of assumptions and not relating them to the model or the experiment shows a lack of understanding. Also the justification of the model is an essential piece of the 'jigsaw'. Often the differential equations seem to be plucked out of the air, or come about through curve fitting.

Where possible, one would like to see comparisons of data in both graph and numeric form.

It is good to see some Centres attempting to model real life situations which are different from the ones usually submitted. This is to be encouraged. However, care must be taken when setting these tasks that the solution of the differential equations reflects the methods taught in this module. Also, that there is scope for modifying the model, not just modifying the parameters.

### **Numerical Methods - 4776**

This was the largest cohort to date for this unit. Many candidates submitted work of high quality, which was carefully and accurately assessed. However, in a significant minority of cases, minor adjustments were necessary, and in a small number of cases the adjustments made were substantial.

Major problems arose when the task was unsuitable, and some lightweight tasks were inappropriately given very high marks. For instance, finding the three roots of a cubic by the Newton-Raphson method does not give scope for a substantial application, or for development in the final two domains. In a small number of cases candidates put their problem in the context of a "real life" scenario, and took measurements from a map, which they then used to estimate an area using one of the methods they were familiar with. Unfortunately they did not appreciate that inaccuracies in their measurements led to all sorts of problems with further iterations and the resulting error analysis. This approach is therefore not advisable.

In some cases all the candidates from a centre tackled the same problem in much the same way. In such situations it is expected that this would result in the second mark in the first two domains being withheld.

In domain 2, replication of bookwork is unnecessary – a simple explanation of why the chosen strategy has been selected is all that is required.

In domain 3, a substantial application can be regarded, for instance, as applying the Trapezium Rule with 1, 2, 4, 8, 16, 32 and 64 strips. This should be enough in most cases to identify a suitable ratio of differences for extrapolation, or to decide on how much iteration is needed to achieve the desired precision.

In domain 4, an annotated print out of spreadsheet cell formulae works well to explain the use of technology. A clear commentary in the text may also suffice.

*Report on the Units taken in June 2006*

In domain 5, it is unlikely that comparing obtained results with the “true value” will be creditworthy. Candidates are expected to achieve convergence by iteration or extrapolation, and to justify their quoted level of accuracy without reference to any known value – whether it be  $\pi$ , or a solution obtained by a graphical calculator.

In domain 6, the first two marks are easily accessible – a formal statement of the solution, to a (justified) accuracy of six significant figures (or better) is expected. For the last two marks, it is usually necessary to refer to the error analysis. A consideration of any discrepancy between the observed and theoretical ratio of differences is usually appropriate.

The most successful candidates had chosen definite integrals to find with unbounded error terms, whose convergence was slower than expected. This gave plenty of scope for development in the final two sections.