



Free-Standing Mathematics Qualification

Modelling with Calculus 6992/2 *Advanced Level*

Report on the Examination *2007 examination - June series*

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General

The candidate entry grew again this year. Although there was a large number of pleasing scripts achieving well over 50 marks out of a total of 60, there were also candidates who achieved less than five marks, many of these scoring zero. It is unlikely that these weak candidates gained much benefit from following the course.

The majority of candidates scored very well on question 1. Good marks were also gained on questions 2 and 3, but, as expected, candidates found questions 4 and 5 more challenging. It is disappointing that in questions 1 and 2, both stating in bold print, “using this model and calculus”, a sizeable proportion of candidates did not use calculus in their solutions. Often, candidates only showed their skill in differentiation in questions 1 part (b) or 2 part (c) (i), when specifically $\frac{d^2V}{dt^2}$ or $\frac{d^2y}{dx^2}$ were required. No marks were given for solutions in question 1 or in question 2, parts (a), (b) and (c), for work which did not involve the use of calculus.

The algebraic skill required in this paper was often found challenging; whilst virtually all candidates could solve the linear equation $2x - 7 = 0$ in question 1, the solution of the quadratic equation $6x^2 - 30x + 32 = 0$ in question 2 part (a) caused major problems.

Question 1

This question was answered well. The weakest candidates ignored the rubric, ‘use this model and calculus’ and scored no marks. Sometimes in part (b) they found $\frac{dV}{dt}$ on the way to finding $\frac{d^2V}{dt^2}$, and earned credit for this.

Question 2

Again the weakest candidates ignored the rubric, ‘use this model and calculus’ and scored no marks. All other candidates found $\frac{dy}{dx}$ quickly, but the solution of $6x^2 - 30x + 32 = 0$ caused problems.

A significant proportion made no real progress in solving this quadratic, whilst a few used their graphic calculators to find quickly $x = 1.54$ and 3.46 . (Naturally candidates were awarded full marks for answers given to 3 significant figures if they had used their calculators.) Those who did obtain both 1.54 and 3.46 as their solutions did not always state which was the appropriate answer. When candidates solved the quadratic $6x^2 - 30x + 32 = 0$ by the use of the formula, the result $\frac{30 \pm \sqrt{132}}{12}$ was frequently turned into $30 \pm \frac{\sqrt{132}}{12}$. The second differential required in

part (c) was usually found correctly, but again a number of candidates only found $\frac{dy}{dx}$ in this part

of the question. The solution of $\frac{d^2y}{dx^2} = 0$ caused no problems. The physical relevance that the

slope of the edge of the fish is steepest when $x = \frac{5}{2}$ was rarely given. Most candidates just

gave the mathematical comment that this point is a point of inflection. Parts (d) and (e) were usually answered correctly.

Question 3

In part (a), most candidates attempted to use the trapezium rule but they sometimes simplified it, or made it more difficult, by using a different number of strips. A number of candidates forgot to multiply their trapezium result by 20 at the front of the integral. Most candidates answered part (b) well, but again a few omitted the factor of 20. In part (c), many realised that integration gave the exact values and therefore was the better answer.

Question 4

This question was attempted poorly. There were few convincing answers to part (a); the correct evaluation of $2 \cos \frac{\pi}{3}t$ with $t = 3$, using $\cos \pi = -1$, was rarely seen. In part (b), the

differentiation to obtain $\frac{dy}{dt}$ was often incorrect. In part (c), few candidates considered the

trigonometric function $\sin \frac{\pi}{3}t$, which clearly had a maximum value of +1. Many equated $\frac{d^2y}{dt^2}$

to 0, attempting to find the maximum value of $\frac{dy}{dt}$, rather than consider the **shape** of the trigonometric curve.

Question 5

A few candidates integrated to obtain $m = \frac{1}{2} \lambda m^2$. However, most candidates appreciated that

they needed to transform the given equation into $\int \frac{dm}{m} = \int \lambda dt$. In the subsequent integration to

obtain $\log m = \lambda t + c$, the constant c was frequently omitted. The conversion from this to $m = Ae^{\lambda t}$ was rarely convincing. Again, the substitution of values when $t = 0$ to obtain the given equation $m = 60e^{\lambda t}$ was not convincing. However, a significant number of candidates made good progress in part (b). The substitution of $m = 120$ when $t = 4$ into $m = 60e^{\lambda t}$ usually

resulted correctly in $2 = e^{4\lambda}$ with $\lambda = \frac{1}{4} \ln 2$. This was often solved for λ to give the two

significant figure answer of $\lambda = 0.17$. This resulted in a lack of accuracy in answers to part (b) (ii).

Principal Moderator's Report

FSMQ Advanced Level – June 2007

There were many very exciting, independently produced portfolios in Using and Applying Statistics, Modelling with Calculus and Working with Algebraic and Graphical Techniques. This is the first year that portfolios have been entered for Using and Applying Decision Mathematics. Just a few centres submitted portfolios but, again, a great deal of pleasing work was seen.

Working with Algebraic and Graphical Techniques Portfolios

Most candidates produced at least two investigations for this portfolio. However, just a few centres failed to realise that it is essential for completeness that an investigation involving the fitting of a function to non-linear data by plotting a linear function is carried out. If such an investigation is not present, the maximum mark achievable is 24. There were excellent examples of the use of software for verification purposes but candidates are reminded that algebra techniques must be demonstrated in the investigations. Investigations involving two different types of function to model different parts of the data set were particularly well done by many centres.

Using and Applying Statistics Portfolios

Candidates made excellent use of material from other subjects to produce very varied portfolios. Although some checking was carried out, candidates should make use of the statistical techniques they have already carried out to check further (for example, considering a scatter diagram and the correlation coefficient). The level of statistical work must be such that techniques beyond the core are demonstrated. For a grade A, more complex techniques such as Mann-Whitney, Wilcoxon, tests of significance or chi-squared tests should be carried out. Indeed, many candidates did use the chi-squared distribution to formulate hypotheses concerning their data.

It was pleasing to see some excellent statistical comments in the critical analysis coursework and many candidates provided alternative diagrams or measures which would illustrate the data more appropriately than those originally included in the reports.

Modelling with Calculus Portfolios

Portfolios were more predictable here, although good examples taken from Physics were seen. Differential equations were well developed by many candidates and some excellent references to the original problem were made by the more able candidates. It must be remembered that, for a grade A, candidates should consider logs, trigonometry or exponential functions. Checking was carried out thoroughly by most candidates, with detailed comparisons being made between numerical methods and calculus methods.

Using and Applying Decision Mathematics Portfolios

Although there were only a small number of entries, a great many were of a high standard. Most centres focussed on one network problem and one problem involving a critical path analysis. It is unlikely that a portfolio without a critical path analysis will show sufficient variety of decision mathematics techniques to be awarded a grade A.

The administration carried out by most centres was excellent and the samples were provided in a timely manner.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the [Results statistics](#) page of the AQA Website.