RECOGNISING ACHIEVEMENT

FSMQ

Additional Mathematics

ADVANCED FSMQ **6993**

Report on the Unit

June 2007

6993/MS/R/07

Oxford Cambridge and RSA Examinations

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This report on the Examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the syllabus content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the Examination.

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Additional Mathematics FSMQ (6993)

REPORT ON THE UNIT

Free Standing Mathematics Qualification, Advanced Level Additional Mathematics 6993

We can report another rise in the number of candidates sitting this examination with an entry of 5500.
I regret to say, however, that we also have to report a rise in the number of candidates who seem, from their scripts, to be entered inappropriately. The specification states that Additional Mathematics is suitable for candidates with (or are expecting to receive) a high grade at Higher level GCSE; for such candidates this specification can be used as enrichment work. When candidates do not even demonstrate an understanding of some material in the Intermediate tier and who gain a total mark in single figures we are left doubting the wisdom of their entry. One candidate even wrote on question 7 "what is calculus?"
For many candidates, the level seemed appropriate but perhaps the paper was a little long; it was evident that some strong candidates did not finish Question 14 for lack of time.

Most candidates gave their answers to an appropriate degree of accuracy, though there were still a significant minority either writing down all the digits seen on their calculator or approximating to only 2 significant figures. As in previous years, examiners deducted a mark where it was seen for the first time (and only once throughout the paper).

Section A

Q1 (Inequality)
A few could not cope with the inequality sign and replaced it with an equal sign and then tried to deduce what the answer might be at the end, rarely getting it correct. Others had difficulty with the manipulation of algebra. For the better candidates it was an easy start to the paper.

Q2 (Variable acceleration)
This defeated all but the strongest candidates. The vast majority of candidates assumed constant acceleration and tried to apply the formulae that they knew to get an answer.
Many who would otherwise have got it correct added the value for *s* at the two end points of integration rather than subtract.

Q3 (Circle)
Many knew what they were trying to obtain (and wrote down the coordinates of the centre correctly) but were once again defeated by the algebraic manipulation.
It is worth noting that $\sqrt{10}$ is the exact value of the radius and is therefore an acceptable answer.
Those who wrote down an approximation were not penalised for having too many significant figures if the exact value had already been seen.

Q4 (Trigonometrical equation)
This question tested not only the identity $\frac{\sin x}{\cos x} = \tan x$ but how to identify the angles in the required range from the value given on the calculator. Strong candidates managed both; others were less than successful. We saw only rarely an effort to square and use the identity $\sin^2 x + \cos^2 x = 1$ with none totally successful.
In this case, correct to three significant figures is also correct to the nearest degree and this was the expected approximation.

Q5 Constant acceleration
Many candidates had difficulty in choosing the right formula to use and then difficulty in identifying the original and final velocities. It was of course possible, and permissible, to find the time first and then the deceleration.

Using the standard notation, $a = -\frac{4}{3}$, giving the deceleration as $\frac{4}{3}\ \mathrm{m\ s^{-2}}$. On this occasion the negative sign and the units were ignored.

Q6 Gradient function
Here the major error was to put the gradient function equal to zero; for these candidates the connection between the gradient function and the gradient of the tangent at a point was missed.

Q7 Maxima and minima
Most candidates were able to find the points where stationary values occurred, though few seemed prepared to factorise. Demonstrating that there is a minimum at $x = 3$ was acceptable in one of three ways; via the second gradient function, the magnitude of the gradient either side of $x = 3$ and the value of the function either side of $x = 3$. Simply saying that the larger value of x is the minimum because the curve is a cubic was not acceptable.

Q8 Area between two curves
Not all candidates were able to find the points of intersection of the curves. It was not necessary to identify which curve was which and so a negative value for the area was accepted. Some candidates subtracted the functions before integrating and others integrated to find the area between each curve separately and subtracting to find the answer. A very small number of able candidates found the area between one curve and the line $y = 3$ and doubled the answer – we would have liked to have given bonus marks for these candidates!

Q9 Coordinate geometry
Part (i) was usually done well, but in part (ii) candidates often halved the difference in coordinates rather than halving the sum. In part (iii) candidates were expected to demonstrate knowledge of the relationship of perpendicular gradients $m_1m_2 = -1$. To say "$m_1 = -\frac{5}{3}$, $m_2 = \frac{3}{5}$ and therefore the lines are perpendicular" is not enough. This is a case where "show that…" requires candidates to demonstrate fully their understanding and knowledge of what is being tested.
A geometric argument was accepted, though this had to be convincing. Simply to say that the triangle ABC is isosceles was not enough, though we did not expect a full proof of congruency.

Q10 Linear programming
The graph of the lines was an easy source of marks and usually candidates shaded the correct part for the two lines. Additionally in this question, candidates were required to show $x \geq 0$ and $y \geq 0$ and many missed this shading.
In part (ii) many candidates assumed that the answer was one of the vertices of their required area and worked out the value of $x + 3y$ at each, concluding correctly the value of 12. Others treated $P = x + 3y$ as an objective function and, by drawing a typical line, deduced the right answer.
A small minority shaded the quadrilateral instead of shading everywhere else.
In questions like this, it is not necessary to plot the lines on graph paper, but it is helpful to use appropriate scales – a scale on the x axis, for instance, that goes from 0 to 50 does leave the required area looking a little small!

Section B

Q11 Polynomials
Part (a) (i) required candidates to solve a cubic equation. Given that there is no constant term in the function, it was expected that at this level candidates would spot that x was a factor and that $x = 0$ was one of the roots. This reduces the function immediately to a quadratic. Those who did spot this completed this part of the question very easily. Others who did not spot it spent a very long time (and much more than the 4 marks would indicate was necessary) trying to find roots by the factor formula.
Part (ii) was a simple sketch; the main failure here for candidates who got the shape of the curve correct was the failure to put any scale on the axes to indicate where the curve cut the axes. Many candidates drew the curve "upside down".
Part (b) was done very much better and many candidates scored all 7 marks here with no marks for part (a).
It is worth noting that long division, carried out correctly, will always demonstrate a root or find the remainder. However, it is also worth noting that this is always very time consuming and may have contributed significantly to the fact that many failed to finish the paper. In part (b)(i), for instance, the value of $g(-1)$ can be found in a single line, while dividing $g(x)$ by $(x + 1)$ takes very much longer; in this case it also introduced a further worry for candidates in that the remainder had no constant term and so it seemed as though something was missing.

Q12 Binomial Distribution
A number of candidates misread the question and set $n = 20$.
For those comfortable with this topic, the first two parts rarely produced any problems.
Finding the probability to use in (iii) caused a problem for some, as did the question to find "at least… "
A few found the remaining terms, thus expending more time than necessary; others took 1 or 3 terms from 1.
Fewer candidates expressed their answers to an inappropriate number of significant figures, but rather more only wrote their answers to 2 decimal places.
It also seemed clear to the examiners that a number of candidates had no understanding of the Binomial Distribution and some little idea of probability, given that we saw some answers greater that 1.

Q13 3-D Geometry
Part (i) was usually completed satisfactorily, though some got the terms muddled in their Pythagoras calculation. A significant number, however, worked out the wrong angle in part (ii), typically one of the other two angles in triangle OCM and rather more frequently the angle OCB. Candidates who thought that this was the angle might have been alerted to the fact that the results of part (i) were not used in this calculation and therefore might have asked themselves what was the purpose of part (i).
We have commented before that we believe that candidates would benefit from drawing the triangles in which they are carrying out a calculation. Had they done so then there would be less likelihood of getting Pythagoras wrong in part (i). Additionally some attempted to use the cosine formula in part (ii) with lengths drawn from different triangles.
To find the volume in part (iii) it was required to find the base area and the height. This defeated many, perhaps because of the multiple steps. Others took the height to be OB or OC and took the base area as $\frac{1}{2}\times 20\times 40$ - again, we wonder whether this error would have occurred had a triangle been drawn.

Q14 Algebraic manipulation

Strong candidates were not phased by the fact that there were non-integer values here. They wrote down the two equations, subtracted to obtain the linear relationship, made *y* the subject, substituted back to give a quadratic which they then solved (sometimes by factorisation!) to give exact answers for *x* and *y*. This was all completed in less than a page.

Others had less success and were let down by algebra.

The question included a "show that…" and candidates should be aware that every step must be written and convincing to obtain the marks.

Some rather startling errors were:

$x^2 = y^2 + 4 \Rightarrow x = y + 2$

$(y + 1.05)^2 = y^2 + 1.05^2$

It was also clear that the rather poor response to this question was often due to lack of time.

FSMQ Advanced Additional Mathematics 6993
June 2007 Assessment Session

Unit Threshold Marks

Unit	Maximum Mark	A	B	C	D	E	U
6993	100	70	60	50	40	30	0

The cumulative percentage of candidates awarded each grade was as follows:

	A	B	C	D	E	U	Total Number of Candidates
6993	**28.8**	**38.6**	**48.1**	**57.5**	**66.8**	**100**	5500

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