OCR
RECOGNISING ACHIEVEMENT

FSMQ

Additional Mathematics

FSMQ **6993**

Report on the Unit

June 2009

6993/R/09

Oxford Cambridge and RSA Examinations

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of pupils of all ages and abilities. OCR qualifications include AS/A Levels, GCSEs, OCR Nationals, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new syllabuses to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support which keep pace with the changing needs of today's society.

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.

OCR will not enter into any discussion or correspondence in connection with this Report.

Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

CONTENTS

Additional Mathematics FSMQ (6993)

REPORT ON THE UNIT

Additional Mathematics – 6993

This year has seen another large increase in the number of candidates sitting the paper. While there are candidates and even the whole cohort from a centre for whom this paper is not suitable, it seems as though the increase is from candidates for whom this paper is appropriate.

The mean mark was 49, up by 5 marks from last year.

Centres are reminded that this is an Advanced FSMQ and therefore has as its starting point a good grade at the higher tier of GCSE. It is evident that there are two types of candidature for whom this paper was not appropriate.

There were candidates who demonstrated a very poor grasp of the work, even of basic GCSE skills. For instance, question 7 deals with the sine and cosine rule and this question could easily be asked in a higher tier GCSE paper. Yet some were unable to even start the question; others could clearly only cope with right-angled triangles. Question 8 required the solution of a quadratic by formula or completion of the square and question 11 the solution by factorisation. A small number of candidates could not cope with either of these. We are concerned that an inappropriate entry of candidates without a good grasp of the higher tier material of GCSE might be a negative experience for such candidates.

There were other candidates who scored well on a limited number of questions and these questions were often well presented. The inference here is that such candidates are mathematically able students who have not covered the syllabus well. The process of entering candidates for this paper for whom there has been no enrichment programme of study (or an ineffective one) could also be a negative experience.

For those who tackled the questions appropriately there seemed to be no difficulty with finishing the paper in time and a number of first class scripts were seen. However, it seemed as though a number of candidates ran out of time; our perception was that these candidates penalised themselves by inappropriate methods of answering some questions. This specification was written with the intention that it should provide an enrichment programme for students who were going to achieve, or who had already achieved, a good grade at GCSE. Methods of approach which might not be seen or expected in a GCSE paper were expected here, and failure to do so by tackling questions in a rather more standard, and long-winded way would have resulted in a loss of time. Examples of this will be identified in individual questions.

It is appropriate to note two points from the rubric. The first is the statement that answers should normally be given to 3 significant figures. Candidates who consistently wrote answers to more (typically the whole display on their calculator) were penalised by the loss of an accuracy mark at the first place it was seen (answers in Q13 on probability were also accepted to 4 significant figures). The second is that marks will not be awarded unless sufficient working is shown. Candidates who therefore simply wrote down the answer without any working were not always allowed full marks for the question.

A few candidates caused themselves as well as the examiners a few problems in their interpretation of a standard examination demand. In question 14 it was required that candidates sketched a graph of a curve and a graph of a line. Since the intersection was part of the question, it was necessary to sketch (or plot) the functions on the same graph. Consequently the question asked "On the same graph". Unfortunately a number took this instruction to mean "on the same graph as you have drawn for a previous question" and drew these graphs on what they had produced for Q10. No penalty was applied for this except for the ones whose graphs (and shading!) for Q10 obliterated the graphs for Q14 so that the examiner could not see anything worthy of credit.

Section A

Q1 Trigonometry and Pythagoras

Most candidates failed to get any marks on this question though some managed a special case allowance of one mark. The crucial problem here was the lack of understanding of the word "exact". Many ignored this demand; others understood it to mean "all the digits on my calculator". Candidates who worked out θ and then $\tan\theta$ on their calculator seemed unaware that the method could not produce an exact answer. It was disappointing also to see so many candidates giving an angle as an answer, and others not even getting an approximate answer via their calculator, meaning that the lack of understanding extended beyond the word exact.

[$\tan\theta = -\frac{\sqrt{5}}{2}$]

Q2 Finding the normal to a curve

Many candidates were able to differentiate and hence find the gradient of the tangent at the required point. Some, however, did not realise that it is not necessary to find the equation of the tangent - one of the places in the paper where time was lost.

[$8y + x + 7 = 0$]

Q3 Coordinate geometry of straight lines

It was disappointing to see the approach by most candidates. The "standard" process was to find first the gradient of the given line by expressing $2x + 5y = 7$ in the form $y = mx + c$ and then to substitute the given point to find c. Very few realised that any line parallel to $2x + 5y = 7$ would have the form $2x + 5y = c$ where c could be found by substituting the given point. This is therefore another question where time would have been lost by a significant number of candidates. No extra marks are available, of course, for alternative long-winded methods; there is also the increased chance of making an arithmetic or algebraic error. Many candidates with this approach, for instance, decided that $m = 0.4$ or $m = 2$.

[(i) $2x + 5y = 27$, (ii) $p = 4.2$]

Q4 The circle

The word "exact" appears again here. Most candidates were able to obtain the length of AB (= $\sqrt{20}$) but were unable to resist the temptation to find an approximate value from their calculator. The result of this was to substitute their approximate value for r into the equation for the circle rather than $\frac{1}{2}\sqrt{20}$, which yielded an incorrect equation.

[(i) $\sqrt{20} = 2\sqrt{5}$, (ii) (3, 2), (iii) $(x - 3)^2 + (y - 2)^2 = 5$]

Q5 Constant acceleration

There were many "double errors" or "omissions" in part (i) in writing down the correct answer and these were penalised. For instance, some found $t = 8$ and thought that that was the answer. Others substituted into the equation $v^2 = u^2 + 2as$, but substituted $a = 0.25$ and ignored the resulting negative sign. Others correctly substituted for a, but interchanged u and v and again ignored the negative sign. Others substituted $a = 0.25$, interchanged u and v and got the correct numerical value for s. Here again is a poor method, taking more time away from the candidate by the poor choice of formula - finding first the value of t and then finding s.

In part (ii) a number of candidates assumed that $v = 0$ which was incorrect. Finding first the actual value of v before using it to find s is a long-winded method.

[(i) 8 m, (ii) 10 m]

Q6 Integration to find equation of curve
This was a good source of 4 marks for most candidates, although a proportion failed to use appropriate methods to find *c*.
[$y = x^3 - 2x^2 + x + 4$]

Q7 Cosine and Sine rules
This question also was a good source of marks for even the weakest of candidates though the usual error of taking 73 – 48cos60 = 25cos60 was in evidence!
In part (ii) a considerable loss of time must have been experienced by those candidates who used the cosine rule twice. The first use resulted in a quadratic for BC which had to be solved and then used in a second application of the cosine rule to get the angle.
Unnecessary marks were lost here by even the most able of candidates. Some failed to answer the question completely in part (i), thus losing the last mark. Some also gave the angle in part (ii) to 4sf or more
[(i) 18 m, (ii) 50.3°]

Q8 Intersection of line and quadratic
Most candidates solved this easily, though a few could not remember the quadratic formula. More time was lost here by finding also the *y* coordinates of the points of intersection, which was not required.
[4.37 and – 1.37]

Q9 Variable acceleration
The usual proportion of candidates used constant acceleration formulae in this question including those who got part (i) correct by integration and then reverted to constant acceleration for part (iii). Responses to part (ii) were poor with only a small proportion saying that the velocity was a maximum value (or something similar). Acceleration = 0 and therefore the car is at rest was often seen.
[(i) 17.5 m s^{-1}, (ii) Maximum velocity, (iii) 533 m]

Q10 Linear programming
This question also took up more time than it should as the vast majority of candidates were unable to sketch, preferring instead to plot. The feasible region was not as most candidates expected, as a result of which they shaded incorrect regions.
[(ii) $y = 2$]

Section B

Q11 Areas under graphs
This question often produced a number of marks for even the weaker candidate. Unlike Q8, the *y* coordinates were required here and a few lost a mark by failing to find them. Those that subtracted the curves before integrating found the answer within a few lines; those that treated the curves separately took rather longer. There were many arithmetic slips, including subtracting the wrong way round and getting a negative answer (the negative sign then being ignored).
[(i) (2,3) and (5,6), (ii) 9]

Q12 3-D trigonometry
The main difficulty in this question was the failure to set out the working carefully and clearly and it seemed at times that the candidates had got themselves lost!
Many failed to understand what angle was required in part (ii). Unfortunately the calculation of the wrong angle led them to tackle part (iii) the wrong way, and a number failed to find BG by the "hence" method.
[(i) 200 m, (ii) 10.7°, (iii) 186 m]

Q13 Binomial distribution

Part (a) required the understanding of the criteria required for the binomial distribution to be appropriate, but sadly only a few candidates wrote anything about randomness. Furthermore, those who did not write about randomness often wrote about there being 100 employees, or even 10 employees, negating a second criterion for the Binomial distribution.

In spite of the fact that many marks were lost in the paper by candidates for failure to write with the appropriate precision, most got part (b)(i) correct, writing enough to convince the examiners that they had not just written down the answer that was given.

Part (b)(ii) required a binomial coefficient and many failed to appreciate this. Some went further to assert that this required a term for three males and a term for three females, equal numbers multiplying and adding. That $20\times(0.6)^3\times(0.4)^3 \approx (0.6)^3+(0.4)^3$ is, of course, entirely coincidental.

Part (b)(iii) required the addition of three terms. One can speculate the reasons why candidates should choose to do this part by the "1 – " method which was, of course, a rather more long-winded way and opened candidates to the error of failing to include the 4th term of males and females in equal numbers.

[(ii) 0.276, (iii) 0.544]

Q14 Roots of cubic

The idea of this question was to lead candidates via three different examples in three different ways to conclude that cubic equations of this form only had one root. Many were able to do so, in spite of losing their way in some of the parts of the question.

In part (a), if the candidate drew something other than a cubic (a quadratic was the usual alternative seen) or if the curve was not extended into the negative quadrants then the conclusion that there was only one root did not follow.

In part (b)(i) something needed to be said about $\frac{dy}{dx}$ such as "= 0 has no roots" or "always positive" for full marks and in part (ii) "crosses *x*-axis once" was not good enough, some reference to part (i) being necessary.

Likewise in part (c) the result that f(2) = 0 or $(x - 2)$ is a factor was often not written precisely enough.

[(c)(ii) $(x - 2)(x^2 + 2x + 5) = 0$]

Grade Thresholds

Additional Mathematics (6993)
June 2009 Assessment Series

Unit Threshold Marks

Unit	Maximum Mark	A	B	C	D	E	U
6993	100	73	63	53	44	35	0

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

	A	B	C	D	E	U	Total Number of Candidates
6993	27.7	39.7	48.7	56.9	66.0	100	9860

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

14 – 19 Qualifications (General)
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553