FSMQ

Additional Mathematics

Free Standing Mathematics Qualification **6993**

OCR Report to Centres

June 2012

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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 specification 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.

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OCR REPORT TO CENTRES

Additional Mathematics – 6993

General Comments

Performance was similar to last year. A creditable number of candidates scored a mark above 90. However, it continues to cause distress to see that 10% of candidates scored 10 or less. There remains a significant number of candidates who appear to have been entered inappropriately; this could not have been a good experience for them.
Algebraic and calculus notation was often poor; comments on individual questions will indicate where this is not simply a matter of sloppy writing, but results in the loss of (sometimes many) marks.

There were a number of equations to be solved and it was surprising to find a number of candidates resorting to trial and improvement methods to find a solution. In some questions the method of solution was part of the test and so these marks could not be awarded. In a significant number of cases, while the process seemed to be successful, the final result was not given to the right number of significant figures and so more marks were lost. At this level, candidates should be comfortable with using the formula or using factorisation methods to find the roots of a quadratic equation, for instance.

Comments on Individual Questions

Section A

1 (i) A significant number of candidates started the paper with a correct solution. The most common error was to check just integers. A few were unable to factorise the quadratic expression.

(ii) A follow through mark was allowed here; a number of candidates did not indicate the ends of the range correctly.

2 (i) Generally this was correct, though a number misread the question and found P(exactly 1). A small number added five terms rather than take one term from 1.

(ii) Generally well done. Only a few failed to include the coefficient or get the powers wrong. A few approximated their answer to only 1 significant figure.

3 (i) Those that applied the factor theorem usually obtained the correct result. Many of those who depended on long division failed to get the algebra correct. This is one of a number of "show that..." in the paper. Candidates need to be aware that in these situations it is crucial that every step is shown in order to convince the examiner that the correct process is being used to obtain the result. Candidates who miss out essential steps will not gain full marks.

(ii) A significant number of candidates did not read the question properly and gave the answer to the question "solve f(x) = 0" rather than simply factorise f(x). The most common error was to start with the expression (x -3), presumably because it was given in part (i), but ignoring the fact that in part (i) this expression was shown not to be a factor.

4 Many candidates were able to obtain at least 2 out of the 4 marks for either the distance or the acceleration. A common mistake was to use different initial speeds for the two parts of the question or take the initial speed to be 0 for both parts.
Candidates need to ensure they are familiar with the formulae required as there were several instances of wrong formulae quoted.

5 (i) Candidates found this question difficult. Many did not know the formula required to prove this part. The two most common mistakes for those who had an idea of the correct formula were to use $\cos^2\theta = \sin^2\theta - 1$ or to use the correct formula but not deal with the factor of 3 correctly. Signs were not considered carefully enough resulting in an incorrect

equation which was then corrected by changing the signs.

(ii) Many candidates did not recognise this as a quadratic they could solve by factorising. Of those who did and went on to solve it correctly, many had a problem with the negative root and decided that -90° was not a root and so discarded it rather than adding 360° to it. Other mistakes included not realising that the positive value has two answers.

6 (i) Most candidates were able to differentiate accurately. Candidates then either substituted $x = 2$ to obtain a value of 0 for the gradient or they set the derived function equal to 0 and solved the resulting quadratic equation.

(ii) Approaches to the second part of the question were more varied. Values of the gradient or y either side of the stationary point need to be "close to" in order to avoid difficulties with the other turning value so using the value $x = 1$ was not given credit. It is worth noting that the use of the second derivative to determine the nature of a stationary point is not stated in the specification and is not a requirement. However, it is a perfectly acceptable method and the vast majority of candidates took this route. An essential part of the process is to be able to assert that the second derivative is positive (ie the gradient function is an increasing function at the point where it is zero). For full marks, therefore, it was necessary for candidates to confirm the point that $6 > 0$.

7 (i) The most common error in this part was to take the angle of the triangle at A to be 30º and not 20º.

(ii) Many candidates found the angle ACB rather than ABC. While this was used successfully to find the bearing, the question asked for the angle ABC and so a mark was lost by some candidates. A number could not determine the bearing from their angle.

8 (i) For a convincing demonstration of the answer that was given, the full working of the integral when $x = 2$ was necessary. While the omission of the working for $x = 0$ was condoned, the jump to the answer given from the integrand was not enough for full marks.

(ii) Some reference to the fact that the curve crossed the axis in the interval and that the values of the area cancelled themselves was necessary. A number of candidates misunderstood the question and referred instead to the fact that the curve crossed the axis between $x = -3$ and $x = 1$ and so the limits were wrong.

(iii) A good number of candidates obtained the correct answer to this part.

9 (i) Most were able to set $t = 0$ to find the answer.

(ii) Very few, however, were able to set $\cos(480t)$ to -1 for this part. Many decided that $t = 1$ would result in the maximum height without further check.

(iii) A number of arithmetic and trigonometrical errors in this part prevented many from obtaining full marks. For some the negative sign was lost.

Section B

10 A question that, in part, tested some core skills relating to coordinate geometry but also included some testing parts that challenged many.

(i) Most candidates could find the midpoint.

(ii) Likewise, the value of the radius was usually found and the equation of the circle obtained.

(iii) The arithmetic seen was usually accepted, though few candidates explained what they were doing or came to a conclusion.

(iv) The product of the two gradients was to be -1 for verification that the lines were perpendicular. Unfortunately, without adequate working it was not possible to discern whether candidates had used a circular argument to obtain the result. This was a clear example of the need to show all working.

(v) A few took the formula for the midpoint between two points to find the other end of the line. A few more worked the vector idea successfully. Rather too many found the equation of the line BM and then did not know how to proceed. By substituting and solving the resulting quadratic to obtain the coordinates of B and D the required result could have been obtained, and a few did so, but it involved rather more work than the other methods for the 3 marks allocated.

11 The question was clearly worded and most candidates knew what was required of them. A good 3 part question which provided a full range of marks with only the very best candidates getting close to 12 marks. Of those who failed to score more than nine marks most went wrong on part (i) and failed to find the correct equation of line AB.

(i) Quite a few candidates failed to differentiate here. Of those who did differentiate successfully a significant number failed to substitute $x = -2$ to obtain the gradient. Many candidates did not know the relationship between the gradient of a tangent and that of a normal.

(ii) Most candidates realised that they should equate their line with the quadratic and most who had the equation of AB correct could see this through to a correct answer. For some, the fact that the coordinates of A were given was a useful check in part (ii) when finding the coordinates of B and some recognised this in their answer.

(iii) Most candidates at all levels understood that the method was to subtract the area under the curve from that under the line. However, there were very few fully correct answers even from candidates who had the correct equation for AB, with a failure to use limits in integration accurately.

12 Strong candidates had few problems and scored full marks. Conversely, weak candidates had little idea and were only able to tackle part (ii).

(i) Although many candidates set up the equations correctly and realised how to solve, there were as many candidates who immediately created problems for themselves. It was not uncommon to see 30^2 and 60^2 unevaluated until one of the variables was eliminated. Some continued to have these unevaluated when eliminating and misconceptions continued: doubling 30^2 say was often given as 60^2. Some candidates seemed to think av^2 meant a^2v^2.

(ii) This was found to be a straightforward source of 3 marks by almost all. Some forgot to subtract, others misread, others insisted their (incorrect) formula generated in (i) was the correct formula to use rather than the printed one!

(iii) Most gained the first two marks for substitution. The next stage was not done well: it was common to see candidates multiply through by 20 and write $v^2 + v - 1000 = 0$ (or equivalent).

The solving process was generally done well by those who used the formula or completed the square on *their* quadratic equation. The trial and improvement method was very much in evidence in this question.

13 As was expected from the last question on the paper a majority of candidates struggled with this non-standard question on the procedure of differentiation from first principles..

(i) The most common mistake was to use Pascal's triangle to acquire the coefficients in the expansion but incorrectly thinking that the expansion being asked for was $(1 + h)^3$ rather than $(2 + h)^3$ so $a = 3$, $b = 3$ and $c = 1$ was quite common.

(ii) This part was done very well by those who realised that they had to first find the y coordinates of P and Q and then consider that the gradient between the two points on the chord is simply the change in y values divided by the change in x values. As this was a 'show that' it was expected that candidates would do a little bit more than simply stating the numerator (which was given).

(iii) Many good candidates did not realise that all was required was to substitute their expansion from part (i) into the gradient of the chord given in (ii) to obtain a quadratic expression in h. Instead they started the expansion of $(2 + h)^3$ from scratch and in a number of cases obtained a different answer than the one they gave in (i). Other errors from those that attempted this part was not to cancel the 8s and so their answer was no longer polynomial; a number multiplied by h rather than dividing by h and, although not penalised, many put their quadratic expression equal to 0.

(iv) All this part required was for the candidate to substitute $h = 0$ into their quadratic function found in (iii) but many found the more formal mathematical language used in this part to be beyond their comprehension

(v) Those that understood what was required in the first four parts of this question had no difficulty in deriving the required answer. Many managed to score the first two marks for arriving at the correct expression for the gradient of the chord but once again failed to obtain the correct answer of 32 by again setting $h = 0$.

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