Oxford Cambridge and RSA

FSMQ

Additional Mathematics

Unit **6993:** Paper 1

Free Standing Mathematics Qualification

OCR Report to Centres June 2017

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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.

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OCR REPORT TO CENTRES

Additional Mathematics – 6993

General
The paper was a little more straightforward this year and many candidates scored well. The mean mark was a little up. The questions that often catch the able candidates are the ones that ask them to "show that..." and often the explanations were thin or missing. Even though such a question might seem to be obvious, enough working must be given to show the assessor that the candidate can produce the answer.

Question 1
This question provided a rather easy start to the paper. However, it was disappointing that a number of candidates did not score full marks. Some were unable to deal with both inequalities at the same time, so dealt with them separately, failing to put them back together again at the end. Others subtracted 1 from the left hand side and middle but not the right hand side. Some only divided some terms by 3.

Question 2
The more efficient method, as set out in the mark scheme, was followed by only a few candidates. The majority chose to find the gradient of the given line, use the perpendicular lines property and then use *y* = *mx* + *c* with their gradient, substituting (3, -1) to find *c*. This was perfectly acceptable, albeit a rather longer way, but inevitably the extra algebraic manipulation resulted in errors. Some candidates took the gradient of the original line to be 2 or -2, others did not do the conversion properly and others made arithmetical errors in the substitution.
The assertion that the original gradient was $-\frac{2x}{3}$ was condoned, however the conclusion that the new gradient was $\frac{3}{2x}$ was not!

Question 3
This question was successfully completed by the majority of candidates with very few incorrect responses. There were some errors and these were:
(i) using the gradient function as *m* in the equation of a straight line with a result of $y = (2x-3)x + c$.
(ii) using the gradient as 2 from $2x-3$ and using $y = \pm 2x + c$ or $y = \pm\frac{1}{2}x + c$.

Question 4
(i) Candidates were generally successful in part (i). The only problems to report are the occasional sign error and a desire to give a decimal answer even after the exact answer has been obtained.
Part (ii) was almost always correct - except when subtraction used rather than addition.

Question 5
Part (i) was generally well answered. Most candidates recognised $r^2 = 50$ but $r^2 = 49$ was also seen. Almost all candidates used the centre (0,0). However some used (1, 7) as the centre and others left their answer for the radius as $5\sqrt{2}^2$.
The responses in part (ii) were more mixed. Many candidates attempted to manipulate their equation from part (i) before substituting, often resulting in variations of $y = \sqrt{50} - x$. Those that substituted correctly generally reached the correct answers for both coordinates although some students are still failing to give their answers as pairs.

Question 6

Given that candidates were told in part (i) that there was a negative root, no credit was given to those who attempted only positive values and a number failed to substitute correctly hence not obtaining f(-3) = 0. Even those that reached this stage often did not understand the difference between factor and root giving (x + 3) as their answer.

Those who had identified -3 in part (i) generally divided correctly and obtained the correct quadratic and most solved this correctly. A number of candidates failed to give all 3 roots or factorised the correct quadratic incorrectly - often $(x-2)(x+2)$ or $(x-2)^2$.

Question 7

Part (i) was a straightforward definite integration question, generally handled very well. Part (ii) was not well done – there were a lot of poor and inaccurate sketches, and only a minority of candidates realised the significance of the graph intersecting the *x* axis between 2 and 5. Only a few were able to articulate their thinking in a clear and accurate way.

Question 8

This was very well done, with confident and accurate work the norm. Some used 6 and/or 24 instead of 4, misreading the question. Others found the probability of exactly 2 sixes showing.

Question 9

The vast majority of candidates tackled this question correctly using calculus with only the weakest candidates attempting it using constant acceleration formulae. Accuracy was high in both parts of the question. Most candidates knew exactly what was required and made few algebraic or numerical mistakes.

The major error here was to ignore the constant to give an incorrect formula for acceleration. This was penalised once though the subsequent calculations (which did not depend on the constant) were credited. This error was avoided by multiplying out the brackets first, though the inclusion of the constant in the formula caused no problems for the majority of candidates who dealt correctly with differentiation. A small number of candidates solved $a = 0$ to find $t = 0$ and 8.
In part (ii) the major error was again caused by the constant. While the majority of candidates dealt correctly with this, many candidates integrated the constant as a separate term resulting in an extra t in the formula for the displacement, a mistake which was avoided by the candidates who chose to expand the bracket before integrating.
Most candidates correctly used substitution. Some candidates included c in their final answers. Candidates could be encouraged to retain fractions within their working rather than converting between decimals and fractions. Once again, weaker candidates incorrectly attempted to apply the constant acceleration equations.

Question 10

As expected this was very discriminatory.
The cosine rule was familiar to all but the task of using it with letters instead of numbers proved to be more of a challenge. The most frequent error seen was a failure to write $\left(\frac{1}{2}a\right)^2$ properly, since $\frac{1}{2}a^2$ is incorrect. Some candidates omitted to make cosADC the subject of their formula.
Some candidates were able to efficiently adjust their formulae from part (i) to answer part (ii).
Part (iii) was poorly attempted, in spite of the hint provided. Many equated the sum of their (i) and (ii) as 180 degrees, and were unable to use the hints provided.
Some candidates that tried to apply the given angle relationship multiplied the numerator AND denominator of their fraction when trying to multiply by -1.

In part (iv), many candidates gave the correct answer and then converted it to a decimal, rather than leaving it in the exact form as the question had specified.
Some candidates did not relate this part of the question back to the other parts, with many candidates failing to spot that part (iv) could be done by just substituting the numerical values into the result of part (iii). It was possible to gain full marks in this part by working it through by applying the basic cosine rule twice. Only a few of these candidates successfully used the cosine rule twice to get the correct answer and some of these were unable to give the exact answer as they lost accuracy throughout their calculation. Candidates were able to obtain the correct answer (albeit with rather more work than the 2 marks of the question warranted) as, whatever value they wrote down for the angle they had retained the correct value in their calculator. Full credit was given for this, though those who did not use their calculator in this way, writing down an approximation to the angle and then inputting that approximation for the next calculation could not get an exact answer as required.

Question 11
Part (i) was a good case where candidates sometimes seemed to think 'it's obvious' and tried to argue the case without reference to the model. A small proportion did not understand the question and failed to use $x=0$. Others substituted 0 for *a* and *b*.
In part (ii), many did what was intended and substituted the two points and successfully solved a pair of simultaneous equations. A significant proportion used the values of *a* and *b* and showed by substitution that the results yielded were 32 and 34. A number substituted just one value of x and thought that they had done enough.
It was pleasing that those who had failed to complete part (ii) had the opportunity to tackle part (iii). There were cases in which the 'use calculus' instruction was ignored or integration was attempted. The function was invariably differentiated correctly and usually equated to 0 although a few equated the second derivative to zero. Solving the equation $-3x^2+9x=0$ produced a surprising variety of answers and an even more surprising variety of methods. 3 alone was popular as were ± 3 and $\pm\sqrt{3}$ If $x=3$ was chosen the corresponding value of *y* was generally found correctly. There were quite a few efficient uses of the second derivative and calculations of gradient either side of $x = 3$ to show that this was a maximum. The modal mark of 5 out of 6 was invariably due to candidates finding *x* = 3 and ignoring *x* = 0.

Question 12
Although part (i) was generally correct, a proportion of candidates had the inequality incorrect.
Part (ii) was well answered, as was part (iii).
The graph required in part (iv) was often marred by sloppy shading. It was sometimes difficult to see which region was being shaded. It is satisfactory in such questions to hatch the side of the line not in the region; scrawling all over the page is what displays sloppy shading.
In part (v) a significant proportion of candidates misread the question. Those that got the point correct then failed to add the values rather than work out the cost at this point. Part (vi) however did ask for this information and so most candidates got it correct.

Question 13
Part (a) was very easy and generally well answered, though some weak candidates stumbled in part (i).
In part (b)(i), most candidates earned two marks for applying Pythagoras correctly, although they did not always state that they were finding XC. Good work here was frequently spoilt by attempts to simplify $\sqrt{x^2-8x+25}$. Incorrect answers to this part inevitably led to no further marks.

Question 14
In general those that could identify which right angled triangles they were using did well. The stronger candidates scored highly on this question with many scoring full marks. It was good to see a variety of approaches being used. Several of the unsuccessful attempts revealed a lack of understanding of the three-dimensional problem and these candidates struggled to work out

exactly which sides and angles were required and they failed to select the correct right-angled triangles with which to work. Successful candidates invariably drew right-angled triangles to support their answers and to clarify for themselves what was needed.

Part (i) provided an easy start and the majority of candidates dealt correctly with the problem, with few errors seen.
There were a variety of methods seen for part (ii). Because candidates dealt with the question in various ways it was important to see what they were doing. The construction of right-angled triangles, correctly labelled, usually yielded the right answer. Candidates should therefore be encouraged to present well labelled diagrams to explain their working. Poor organisation and labelling of working often resulted in confusion for the candidate. Poor setting out of solutions also sometimes lead to candidates choosing the incorrect values to use in subsequent working.
Many candidates dealt correctly with part (iii), with most able to identify the correct angle. Those candidates using incorrect values from earlier question parts were more likely to gain the method marks if their working was clear and included labelled diagrams.

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