Oxford Cambridge and RSA

FSMQ

Additional Mathematics

Unit **6993:** Paper 1

Free Standing Mathematics Qualification

OCR Report to Centres June 2016

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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

Candidates found one or two questions tricky and the mean score was a little down on last year. Centres will be aware that the assessment cannot test all the specification content in one examination; the requirement is to cover the whole specification within a few years. There is no requirement within the specification for specific proportions of the assessment per topic. Consequently, the percentage of the topics will vary from year to year. Candidates who are thoroughly prepared for the examination will find no difficulty with this, but those who are prepared for specific topics could struggle.

Question 1

This was an easy start to the paper and most candidates obtained the correct answer. The most common error was incorrect processing of signs leading to $1-2x-6>4x$ and a final answer of $x<-\frac{5}{6}$. Much less common, though more disturbing at this level, was to write $1-2(x-3)=-1(x-3)$. Very few had to be penalised for using treating the question as an equation.

Question 2

There were very few incorrect answers to this question. A very small percentage of candidates differentiated and it was rare to see the coordinates substituted the wrong way round. Just a few were penalised for not writing the equation properly as '*y* =.....'.

Question 3

The most common error was to obtain $\tan x=\frac{3}{4}$ rather than $\tan x=\frac{4}{3}$. The second most common error was in not obtaining the 2nd value correctly.

The alternative method was to square both sides and use Pythagoras.

However, there are problems with this approach because the result $\sin^2 x=\frac{16}{25}$ or $\cos^2 x=\frac{9}{25}$ will yield 4 values for *x*, 2 of which satisfy the equation $\tan x=-\frac{4}{3}$. There is a fair amount of extra work to obtain the correct answer by this method as the values that do not satisfy the given equation need to be rejected. This is a typical case where an alternative method is perfectly acceptable but takes very much more time.

Question 4

(i) Most substituted the correct value but there were a few who substituted $x = -2$. This was a "show that" question and so all the calculations need to be shown.

An alternative method was, instead of using the factor theorem, to divide f(x) by ($x-2$) to show that there was no remainder. This was a lot of work for 1 mark, but fortunately on this occasion what was done could be used in part **(ii)**.

(ii) The derivation of the quadratic factor was required here but credited if it was seen in **(i)**. Clearly it was not sufficient to say that the quadratic factor did not factorise. It was necessary to set it equal to 0 and to attempt to solve, usually by showing that the discriminant was negative. Some substituted factors of 6 into the cubic in an attempt to show 2 was the only root which was also clearly insufficient as it depends on any roots being integers.

It was disappointing to see candidates who had been successful so far writing "therefore (x– 2) is the only root".

Question 5

(i) This was successfully completed by the vast majority with just a few adding together the smallest lengths for all three sides.

(ii) Most candidates correctly used the cosine rule and gained the method mark without necessarily finding the correct angle. A number made several attempts with different combinations of lengths without appreciating the geometry of the problem. Some candidates appeared to be wary of using 20.5 as an upper value and opted for 20.4. Some even used inconsistent values such as 11.5 and 12.5 in the numerator and denominator of the cosine rule. It was a good discriminator as candidates were required to think to select the correct combination of lengths.

Question 6

(i) The majority of candidates found this a very challenging question with the 100 m difference creating a conceptual difficulty in applying the equations of motion. A significant number wrote down all the equations of motion that they could remember, made a faltering start and moved on. A number did successfully obtain the correct answer by trial and error but others amazingly got 400 m by rather more dubious means. Often the values of 1.5 and 2 were used as velocities rather than accelerations and a common result was 2 × 200 s. This question clearly differentiated between those who could apply their knowledge to a problem and those who could not.

(ii) This part was not attempted by many who had failed in part **(i)** but those who had found a distance in part **(i)** often obtained the method mark in this part.

Question 7

The three dimensional nature of this problem caused difficulty to many candidates who could not appreciate the nature of the isosceles and right-angled triangles.

(i) Many candidates used unnecessary calculations and the result was not stated often. Many found PB in this part and did not mention it in part **(ii)**.

(ii) Strong candidates realised that triangle PQB was right-angled at P and proceeded to get 4 marks in a couple of lines. Others, however, found BQ by very long-winded ways including the application of the sine or cosine rule in the right-angled triangle. Some did not appreciate where the right angle was and used the incorrect ratio. This was another question that tested the ability of candidates to apply their knowledge in unfamiliar circumstances.

Question 8

(i) While most candidates were successful with this question a surprising number struggled with the expansion. Even those who expanded $(1+\delta)(1+\delta)$ then multiplied the result by $(1+\delta)$ often made careless numerical errors. The most successful candidates used Pascal's triangle, although there were still careless errors, leaving the answer as $1^3+3\delta+3\delta^2+\delta^3$, forgetting the coefficients or giving every term a coefficient of 3.

(ii) Few students were clear or confident in their explanations. Most recognised the squared and cubed terms would be smaller, and have less significance or make less difference but few proceeded to say they were so small to be negligible, or approximated to zero.

(iii) Most correctly substituted and a number used the guidance provided in part **(ii)**. However, too many candidates expanded $-0.9(1+\delta)$ incorrectly, obtaining $-0.9+0.9\delta$ and thus an incorrect answer. Even those who did this correctly and found δ, often did not go on to find x. This shows a lack of attention to detail that is concerning at this level of mathematics.

Question 9

(i) This part was generally well answered. The vast majority of candidates differentiated correctly. Some then set this equal to zero and attempted to solve it but most substituted $x = 3$. There was again some careless numerical work resulting in 12 as the gradient rather than 6, however generally the gradient was used with the correct coordinates to find the equation of the line. There was some carelessness arithmetic. For instance, $y + 5 = 6(x - 3)$ often became $y = 6x - 13$. A number of students used the normal gradient instead, a lack of thoroughness in reading the question.

(ii) This part was less well answered. Candidates recognised that the gradient of 6 was relevant and needed to be used but many were unsure how to use it. A number tried to use the equation of a line with 6 and obviously had no direction with which to continue the question. Many candidates did correctly equate $\frac{\mathrm{d}y}{\mathrm{d}x}$ and 'their' 6 and then solve correctly to obtain the correct x value. From this point there was again a disappointing number of careless errors when substituting to find y; this lack of scrupulousness cost marks here and elsewhere in the paper.

Question 10

(i) This question, in common with previous years, was very well answered, the vast majority of candidates achieving full marks. There were the usual and expected mistakes of shading the wrong sides, not plotting accurately enough, or confusing the axes so the lines were plotted incorrectly, but on the whole candidates were very successful.

(ii) This part was less successful than part **(i)** although candidates were generally accurate. A few just identified the relevant point and did not find the maximum amount; others attempted decimal points or points outside the feasible region resulting in incorrect answers.

Question 11

A large number of candidates made little or no attempt at this question, possibly because they thought it was simply a mechanics question. Very few scored full marks.

(i) The most common error was to say OP = 20t and similarly for OQ.

(ii) Of those who made it successfully to this part, a large number failed to get the final A1 mark through faulty expansion – not least because of the number of 0s involved!

(iii) A fair number made some headway this part, though by no means all equated their derivative to zero. Some candidates seemed to be uncomfortable with finding $\frac{\mathrm{d}y}{\mathrm{d}x}$ when "y" was not a function of x but of x^2.

(iv) This part was generally very well answered even by those who had made little headway in the other parts.

Question 12

This was an easily accessible question, but despite a high level of competence in algebraic manipulation, better training in setting out solutions more systematically would lead to fewer errors.

(i) Many candidates understood the concepts behind this question and were able to access this part. Very few were unable to produce the correct "negative reciprocal". Where there were errors it was often in the collecting together of the constants after the values (8, 3) had been substituted into the correct equation.

(ii) It was a rare candidate who failed to recognise that this was a question on simultaneous equations. Most chose the sensible method of substitution to solve them and did so successfully, although elimination was also seen. Testing which points lay on both lines was rarely seen. A small minority made mistakes in basic arithmetic and were unaware that they had done so; centres should encourage students to check their answers. Rearrangement of the equation $3x - y = 1$ to $y = 1 - 3x$ was an error seen not infrequently.

(iii) Many candidates knew how to find the length of a line. Those who had obtained the coordinates of Q successfully in **(ii)** went on to get this part correct on the whole. Many candidates converted to decimal form, but centres would do well to encourage surd form, especially as decimal form usually encourages writing numbers to, say, 3 significant figures.

(iv) Nearly all students knew the basic formula for the equation of a circle and most knew that the radius was their answer to part **(iii)**. One fairly common error was to halve the answer obtained in part **(iii)**. Another was to give the radius and not the radius squared. Here, candidates with an approximate answer in **(iii)**, obtained only an approximate answer here, and this was penalised.

(v) This was, as expected, very discriminatory part with only a small minority of candidates knowing how to find the point on the line, although many knew that parallel lines have equal gradients. Candidates should be encouraged to draw their own rough diagrams for geometry questions to help them with problem solving strategies. With a diagram, the vector can clearly be seen and the point found. Candidates who embarked on finding the points of intersection of the circle with a general line of the form $y = 3x + c$, presumably to find the values of c that gave coincident points, could not work it through to completion. This would be another example of an alternative, long-winded, method that would require much more work than the marks available would justify.

Question 13

Although this question was of a familiar type, and expressed in terms of money, which usually makes it easier for candidates to realise what is going on, it still proved challenging to many.

(i) The majority of candidates who were making a reasonable attempt at the paper were able to gain both marks, albeit some of them having mixed units.

(ii) When there were two fractions from part **(i)** to be combined into an equation, the expected error of 5 being added to the wrong term was quite common. A surprisingly common error was to multiply one of the equations by 5, in effect, saying that five times as many buns could be bought rather than five more.

Assuming there was an equation of the correct form, fractions were usually cleared successfully. A significant number of candidates who had the wrong units in their initial equation then realised part way through that there was a problem and tried to adjust, not always successfully. Consequently, there was plenty of 'fudging' evident. This also included those who had added 5 to the wrong term in their initial equation and obtained the wrong sign in the printed answer.

(iii) A good number of candidates showed sound examination technique by picking up the question at this point, even when the first two parts had defeated them. Ironically, those who didn’t and left this part blank, had already demonstrated success on similar work elsewhere in the paper!

The formula was the usual method of solution, and the correct answers found and usually expressed in context. Some candidates continue to misquote the quadratic formula or make careless slips when substituting in values.

Those who chose to factorise were normally successful. Completing the square, as expected, was the least common and least successful method of solution.

Some candidates should have been alerted by their impractical answers: loaves for 7p, for example!

Question 14

(i) Many candidates were able to answer this question correctly. The type of mistakes that were seen when forming the two equations included candidates not dealing with the negative sign correctly when squaring or to form a quadratic by having a^2 in the equation.

Most candidates were able to go on correctly to solve the simultaneous equations with sufficient working shown. Some candidates did not read the question and showed that the values worked rather than solving the equations.

Candidates who had more success in solving the two equations usually attempted to do so with the equations in their simplified form.

(ii) Most candidates were able to find the midpoint but not all went on to show that this point was on the curve. Some attempted to but did not show sufficient evidence by evaluating the indices.

(iii) Many candidates appreciated the need for integration for this question. Many were able to integrate the curve correctly and the majority recognising that this was not the complete answer. Finding the equation of the line was good but the combination of subtracting two areas with negative limits proved too much for many. This was compounded by the fact that most candidates used integration to find the area under the line, rather than find the area of a trapezium.

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