FSMQ

Additional Mathematics

Unit **6993:** Paper 1

Free Standing Mathematics Qualification

OCR Report to Centres June 2014

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

Once again, the overall statistics of achievement by candidates is marred by a small proportion who gains very few marks. It is particularly distressing to see candidates scoring only in single figures. The specification is intended as an enrichment specification for bright students and we feel that scoring very few marks is not a good experience for these candidates.

The mean mark for this paper was 51%, a reduction of 3 marks on the entry for last year. This does not mean that the content of the paper was harder, but it may be that there were some tricky applications required of some basic topics.

Comments on individual questions

Section A

Q1 (Inequality)
Most candidates found this a good start to the paper. A few were unable to cope with the double inequality (for instance, adding 1 to the right hand side but not the left) and a few were clearly working on the ideas of similar questions in previous years by writing down a list of integers that satisfied the inequality.

Q2 (Calculus – finding the equation of a curve)
A surprising number of candidates were unable to understand this question. They substituted $x = 1$ into the derived function and then found the equation of the line with this gradient. This of course is the equation of the tangent at the given point which was not the question. A few failed to finish the question by not finding the constant of integration and a few failed to get their simple arithmetic right. The question asked for the equation of the curve. We therefore expected to see "y = ...".

Q3 (Calculus – area under a curve)
There were, as usual, a proportion of candidates who differentiated instead of integrated to find the area in part (i); again there were some simple arithmetic errors. In part (ii) it was intended that candidates realised that moving the curve up the y-axis meant that the area was increased by the area of a rectangle. A number simply added 10 to their answer to part (i), but the majority started again with the new curve, not seeing any connection. It was disappointing to see some able students failing to understand this, particularly in light of the fact that by this means part (ii) was longer than part (i) and yet only carried one mark. It is worth noting at this point that here, and elsewhere in the paper, the presentation of an integral was very poor. Often limits were omitted from the first integral statement, though used correctly later, and the lack of "dx" was worryingly prevalent.

Q4 (Rate of change)
Many candidates, when faced with such a question, are unable to discern whether they are being tested on constant acceleration (requiring the constant acceleration formulae) or rate of change requiring calculus. Consequently, many candidates spent a lot of time getting nowhere. Others were unable to interpret the question in terms of the need to set the velocity equal to zero to find the time taken in part (i) and then with this time to find the distance between the stations. Some candidates took the rather simple quadratic in t (there is no constant term) and attempted to solve using the formula. Without the constant term candidates often became confused and decided on incorrect and often highly unrealistic answers. Use of the formula is, of course, a correct method but it was surprising how many candidates were unable to write down the correct formula.

Those without a value of t from the first part were unable to continue with the question.

Q5 (Trigonometry and the Sine Rule)
The ability to sort out the angles in the triangle was distressingly weak in part (i). Bearings were not properly understood and some unrealistic answers were seen. The lack of the correct angles had a knock-on effect for part (ii), though marks were available for using the sine rule correctly and for calculating the distance travelled in 30 minutes.

Q6 (Cubic functions and equations)
This was perhaps the least well answered question in Section A. Candidates were expected to develop two simultaneous equations in a and b and solve simultaneously. Doing an algebraic long division in this situation caused complications over how to determine the remainder. Those who did it this way usually found one equation and then made a wild guess. Some who appeared to know what to do took f(–3) = 0 rather than f(3) = 0.

In part (ii) many ignored the information of part (i) and started again with arbitrary factors; these sometime worked and sometimes they did not. The idea that the product of roots was $-b$ and so the only possibilities to try were ±1, ±2, ±3 was hardly ever seen. Those that used the fact that (x – 3) was a factor of the cubic function did not need this of course as their problem was to factorise a simple quadratic.

Q7 (Coordinate geometry and the circle)
While most candidates were able to work out the distance between two points, not all understood the meaning of the word “exact”. It was pleasing to see so many candidates write the answer as $2\sqrt{5}$, which is a better answer than $\sqrt{20}$, but disappointing that they then went on to write 4.472....
In part (ii) most were able to recover by using exact values to get the correct equation for the circle, but a few approximated their length in part (i), divided by 2 to get the radius, then squared to get a number that was different to 5.

Q8 (Coordinate geometry of a quadrilateral)
There was some GCSE knowledge required here and a significant number of candidates did not seem to have that knowledge. Those that did understand what was required often fell down in their explanations which were usually quite poor.

In part (i), quite apart from those that could not find gradients, many thought that the definition of a parallelogram required one pair of sides to be parallel, not two. In part (ii) likewise, many thought that all that was required was to see that one pair of sides were equal in length. The fact that the quadrilateral had already been shown to be a parallelogram meant of course that it was sufficient to show that one pair of adjacent sides were equal, but where this was seen it was not explained carefully enough that as the quadrilateral had been shown to be a parallelogram then it was a property that opposite sides were also equal.

In part (iii) many lost a mark by not explaining how they knew the sides were not perpendicular. It was necessary to state the property of perpendicular lines ($m_1 \times m_2 = -1$) to earn full marks.

Q9 (Trigonometry)
A number of candidates lost a lot of time on part (i) and might have realised that the result was very short, due to there being only one mark allocated. Examiners needed evidence of

Pythagoras being used. Some poor algebra was evident here, which combined with some incorrect trigonometry, resulted in answers such as $\frac{1-\cos^2 x}{1-\sin^2 x} = \frac{-\cos^2 x}{-\sin^2 x} = \frac{\cos^2 x}{\sin^2 x} = \tan^2 x$.
In part (ii) a number did not use the identity of part (i) and usually got lost. Some who obtained values for tan$x$ thought that tan$x$ = –3 was not a valid result and so rejected it, missing a part of the solution or were unable to find the appropriate angle from their calculator display.

Q10 (The normal to a curve)
Part (i) was usually done well. In part (ii), however, many candidates saw the derived function of $4x + 1$ and decided that the normal gradient was therefore $-\frac{1}{4}$.

Section B

Q11 (Maximum and minimum)
This was a standard development of the volume of the box and most candidates achieved the result in only a few steps. It was necessary only to have sight of the lengths of the sides and to see the product being found.

It was pleasing to see that a number of candidates who failed to obtain the result in part (i) were able to use the result given to earn marks in part (ii). This part was usually done well. Even those who did not complete part (i) were able to start with the differentiation to find the two stationary values. Many candidates failed to simplify their quadratic equation by dividing throughout by common factors leading (for those using the formula) to some pretty hefty (and unnecessary) arithmetic. Since arithmetic is not always a strong point for candidates, many errors were seen in what should have been a straightforward process.

In part (iii) it was not satisfactory to assert that the rejected value gave a negative volume as the reason for the rejection. The reason required was to be able to say why one of the values should not be used to find V so it was the fact that one side became negative with the larger value. It was acceptable to find the second derivative and to substitute and use the fact that a negative value indicated a maximum value even though this method of determining the nature of stationary values is not in the specification. It was, however, quite a lot of work for only one mark. There were many spurious and wild suggestions as to why one value should be rejected, such as “you cannot use a recurring decimal to calculate the volume as it is too hard”.

Q12 (Constant acceleration)
There were some very odd expressions given for the time and in particular many candidates were confused over units, not aware that x has no units. So we saw expressions such as $\frac{15}{x \text{ km/hr}} + \frac{15}{x - 2\text{km/hr}}$ resulting in a muddle over the next part. Many simplified the addition of fractions in part (i) which was expected in part (ii) (and marks assigned here) but full marks were given for correct simplification wherever we saw it.
A common misunderstanding of the question was to find an average time for the whole journey, giving the answer as $\frac{15+15}{x+x-2} = \frac{30}{2x-2}$.
In part (iii) one of the roots of the quadratic equation has to be rejected, though in this question we did not demand a reason for it, and then the answer had to be given in correct units – in other words we needed to know Paul’s average speed and not just the value of x.

Q13 (Linear programming)
The majority of candidates achieved the correct inequalities in part (i) and were able then to draw the correct lines and shade appropriately to show the feasible region in part (ii).

Part (iii) caused more of a problem. Some candidates did not actually state an objective function, though subsequent working indicated that they knew what it was. Some candidates wasted time finding the point of intersection of two lines; because this was not an integer point it was not required. What was required was evidence that some of the possible points were tested to find a maximum value. Candidates failed here in many ways including not testing at least two points, not including the correct point in the list of points being tested or performing some incorrect arithmetic. Usually it is the point of intersection but when there is a practical context and the point of intersection is not an integer point then candidates need to be aware that some different work needs to be done.

Nonetheless, this question was a good source of marks for most candidates.

Q14 (Probability)

The two conditions required in part (i) were the constant value of p and the independence of each event from all others. Very few candidates were able to give these conditions.

Parts (ii) and (iii) were often very muddled and it was difficult to discern what candidates were trying to find out. A simple statement such as
" P(unsatisfactory) = P(two or more imperfect mugs) = 1 – P(0 or 1 mugs imperfect)"
would have clarified for the assessor what was being found and must surely have clarified the plan for the candidate. A significant number in both parts seem to have set out in the right way, but got lost along the way.

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