STEP 2 2015 Report

As in previous years the Pure questions were the most popular of the paper with questions 1, 2 and 6 the most popular. The least popular questions on the paper were questions 8, 11 and 13 with fewer than 250 attempts for each of them. There were many examples of solutions in this paper that were insufficiently well explained given that the answer to be reached had been provided in the question.

Question 1

This was a popular question, but a number of common errors resulted in a relatively low average score for the attempts made. A number of candidates did not appreciate that it is necessary in the first part to show both that the gradient is positive for all relevant values of x and to check the value when $x=0$. Additionally, many candidates failed to note that the next part of this question instructed them to use the result shown in the second section of part (i) and instead used a graphical method. Other common errors included an incorrect use of the chain rule in the second part leading to a sign error and incorrect statements of formulae for the sums.

Question 2

The average mark for question 2 was the highest on the paper with a large number of good solutions produced using a wide variety of different methods. However, many solutions did not explain clearly the method being used – it is advisable to make every step of the solution clear, especially in the case of questions where the answer that is to be reached has been given. In many cases the diagrams drawn were not sufficiently large to allow candidates to work easily on the question and on a number of occasions the sizes of two angles were reversed in the diagram leading to other points being in the wrong position on the diagram.

Question 3

On the whole attempts at this question were good with a significant number of candidates obtaining full marks. In the first part of the question a number of candidates did not interpret the difference between successive terms of the sequence as triangles which included a particular length edge and chose to enumerate all possible cases – if this was carried out correctly it was still possible to achieve full marks on this section. Even when unsuccessful in this part of the question many candidates were able to write down correct expressions for the general cases. The proof by induction was generally well done, although a number of candidates failed to justify the first case fully (which can easily be done by enumerating all of the cases). The final part of the question (the corresponding result for an odd number of rods) was not attempted by all candidates. Of those that did, those who attempted to use induction rather than applying the result from earlier in the question struggled to reach the correct answer.

Question 4

This was a generally well attempted question, although it was a common error to draw graphs that were not continuous, even in some cases with statements that they were continuous. Marks were also lost through mislabelling of points on the graphs or through incorrect attempts to use arguments based on graphical transformations to deduce the shape of the graph. A number of candidates when trying to find the stationary points stated that they were going to differentiate a function, but then integrated it.

Question 5

This question had one of the lower average marks for the Pure maths questions on the paper. Most candidates were able to produce a proof by induction for the first part, but the vast majority failed to realise that there was more that needed to be done to prove the result stated in terms of arctan. As is the case for a number of other questions, candidates need to give a clear explanation of each step of the solution. Where candidates identified the relationship between the two parts of the question the second part was generally well attempted.

Question 6

This was the most popular question on the paper with over 1000 attempts made. The first section did not present significant difficulties to candidates and the integration was generally well completed, although occasionally with an error in the factor. The second part proved difficult for a number of candidates who failed to change the variable in the integral correctly, or in some cases did not change the variable in every position that it occurred. Other candidates did not apply a correct result for dealing with the trigonometric functions involved or did not clearly show how the required result was reached as the solution jumped through several steps to a statement of the result asked for in the question. There were very few successful attempts at the final part of the question, but they did include a variety of methods for evaluating the integral once the substitution had been made.

Question 7

The first part of this question was generally well answered, although a significant number of answers did not give the equation of the new circle. The case in part (i) where the two circles have the same radius was often not considered and the explanations for there not being such a circle in some cases were often not sufficiently clear. A significant number of candidates made the incorrect assumption in the second part that the centres of the three circles must lie on a straight line or attempted this part of the question with incorrect methods, such as equating the equations of the two given circles. In the final part of the question not all candidates realised that y^2 must be positive and were unable to obtain the required inequality by any other means.

Question 8

This was one of the least attempted questions on the paper and the average score for the question was quite low. However, there were a number of very good answers to the question. Part (i) was answered correctly by the majority of candidates, but part (ii) was approached in a much more complicated manner than necessary by many candidates, attempting to work out the equation of the line rather than comparing vectors in its direction. Where the vectors were considered, solutions could have been made clearer by better grouping of the terms. A number of solutions referred to division of vectors rather than comparing coefficients. In the final part some candidates did not identify the simplest relationship between the vectors to ensure that Q lies halfway between P and R. Generally, more complicated relationships did not lead to correct solutions to this part of the question.

Question 9

This was the most popular of the Mechanics questions, but many candidates struggled to achieve good marks. In the first section many candidates had difficulties in finding the correct angles to work with – a clear diagram is very helpful in tackling this problem. Candidates often introduced new notation to help with the steps toward the solution, but this was sometimes poorly chosen and made solution of the problem more difficult. Explanations of the methods being used were also often poor – in particular the triangles being used at different stages were not clearly identified. There were also a number of errors when taking moments or when recalling exact values of the sine and cosine functions. There were a number of good attempts at the second part of the question, but a large number of candidates calculated the kinetic energy incorrectly.

Question 10

This question received generally very poor attempts, including a large number of partial attempts. The majority of attempts failed to get the correct expression of the velocity in the first part and this limited the number of marks that could be awarded for the remainder of the question. A very small number of attempts were awarded full marks and there were a considerable number of attempts in which correct methods were attempted following an incorrect solution to the first part of the question.

Question 11

This was the least popular question on the paper. Many answers to the first part did not give good explanations of the method for obtaining the velocity of A. Similarly, in the second part there were a number of statements such as “conservation of velocity” or “conservation of the modulus of momentum” used to support the answer without sufficient explanation to show that a valid method was being applied. Those candidates who attempted to use the equations of motion under uniform acceleration were unable to reach the solution. Part (iii) was very poorly answered with almost no correct solutions offered. In the final part of the question very few candidates were able to identify the part of the reasoning that led to v not being equal to zero in all of the cases identified.

Question 12

Many solutions to this question did not include sufficient explanation to gain full credit. In the first part, marks were not awarded simply for stating that the value of ¼ could be achieved by multiplying ½ by ½ (often with an additional multiplication by 1) – an explanation of where this calculation comes from was also required. In the second part a number of candidates stated that it was symmetric and so the answer must be ¼ but with insufficient explanation why. In part (iii), some candidates obtained a geometric series which was then summed to get the probability of C winning if the first two tosses are TT. In the final part some correct answers were offered, but without explanation of the method. A number of candidates made incorrect assumptions such as that $p+q=1$, or $p+q+r=1$. When finding the probability that C wins a lot of candidates were able to achieve some of the marks by working out the probability in terms of q.

Question 13

This was not a popular question and those solutions that were offered generally showed a limited understanding of continuous probability distributions. The integration that was required was also generally quite poorly carried out. Often these mistakes made it difficult to answer the final section of part (i). Part (ii) was only attempted by a small proportion of candidates.