STEP I 2017 Examiner's Report

The pure questions were again the most popular of the paper with questions 1 and 3 being attempted by almost all candidates. The least popular questions on the paper were questions 10, 11, 12 and 13 and a significant proportion of attempts at these were brief, attracting few or no marks. Candidates generally demonstrated a high level of competence when completing the standard processes and there were many good attempts made when questions required explanations to be given, particularly within the pure questions. A common feature of the stronger responses to questions was the inclusion of diagrams.

Question 1

This was a very popular question, attempted by 94% of the candidates. The substitution was often correctly made for the first part and a large number of candidates were able to identify the similar substitution required for the second integration.

The substitution for the first integration in the second part of the question caused some difficulties, but was again completed successfully by many candidates; however it sometimes required a number of attempts before the correct substitution was completed. A small proportion of the candidates were then able to complete the final integration successfully.

Question 2

This was the third most popular question on the paper, after questions 1 and 3.

Many candidates were able to show the result required in part (i) and to explain why the result also holds for the second range of values of x. However, a number of the solutions did not use integration as instructed by the question and so were not able to achieve all of the marks for the question. The second part was also carried out successfully by a large number of candidates and, as there was no specification that integration should be used for this part, a number of alternative solutions were also able to achieve full marks, providing that they started from the given inequality as instructed.

In the final part of the question most candidates were able to perform the required integration successfully and, while some were unable to follow through to reach the required final result, many did complete the question successfully and achieve full marks.

Question 3

This was another popular question, attempted by 94% of the candidates. The average mark achieved on this question was the highest of the paper and there were also more fully correct solutions for this question than any other on the paper. The majority of candidates appeared to be able to identify the steps that needed to be taken to complete this question and were able to perform the appropriate operations competently.

The final part of the question involved calculating the area of two triangles and many different valid approaches were seen. In many cases the successful solutions were accompanied by clear sketches, which enabled most of the remaining work to be completed successfully, or with only minor errors.

Question 4

This question was attempted by just over half of the candidates. The sketch required in the first part was generally very well done and most candidates were able to identify the appropriate features of their graph to explain the number of possible values for S. Many candidates were then also able to perform the appropriate substitutions to reach the required equation.

When tackling part (ii) many candidates were able to see how to apply the same line of reasoning to the amended situation. In many cases this was completed successfully, but a number of candidates failed to include the value of q that corresponds to the minimum point of the graph in the set of values that determine T uniquely. When trying to find the equation at the end of this part of the question some candidates struggled with rearranging to achieve a quadratic equation.

Question 5

This question attracted a relatively small number of attempts, many of which did not make very much progress and so did not score very well. As a result this question had the lowest average mark among the pure questions. Those candidates who did make some progress, however, often managed to produce quite good solutions and so there were still a number of attempts that were awarded full marks.

The majority of the successful attempts were accompanied by a clear diagram, which helped in understanding the situation as described in the question; candidates were then often able to follow through the steps as required.

Question 6

This question received the smallest number of attempts of all of the pure questions on the paper, a significant proportion of which did not go beyond an attempt to prove the first result before abandoning the question. The average mark for the question was therefore quite low. There were however a number of good responses to the question.

The proof by contradiction in the first part often received a partial explanation. Where the link between parts (i) and (ii) was seen candidates were often able to make good progress on the second part, although some errors in calculation occasionally led to incorrect examples of the function required.

Part (iii) required more care to work through successfully and only a small proportion of the candidates were able to see how to apply the previous result and then complete this part successfully.

Question 7

As with questions 5 and 6, question 7 attracted a small number of attempts compared to the other pure questions. It again received quite a low average mark, partly due to a large number of brief attempts which did not score any marks before the question was abandoned.

Diagrams again proved very useful in tackling this question and many candidates were able to solve part (i) correctly. The first equation to be shown in part (ii) was often reached accurately, providing that the relevant formulae were remembered correctly and many candidates were able to see how this led to the conclusion that the triangle is equilateral.

In part (iii) many candidates were able to show that the first condition implied the second, but there were some solutions that did not make it clear that the required implications worked in both directions for this part of the question.

Question 8

This question received a relatively high number of attempts, although many did not progress very far and so the average mark for this question was again quite low.

Many candidates were very competent with the process of proof by induction, although the fact that the question involved two related sequences caused difficulties for some. There were then a number of good solutions to part (i), but many did not manage to justify the limit of the sequence clearly enough to secure full marks.

The difficulty often encountered in the final part was in showing the first result. Often those who successfully achieved this were able to complete the rest of the question successfully.

Question 9

This was the most popular of the Mechanics questions, but still less popular than half of the Pure questions. Of all of the questions on the paper, this is the question that received the lowest average mark. Many attempts were able to produce the correct equations for the horizontal and vertical components of the motion. The differentiation required to then establish the result in part (i) proved quite complicated for many candidates and so many did not reach the required result.

Those who got as far as part (ii) were able to draw some conclusions about the relationships between the two angles, but struggled to reach the simplest form. Only a few candidates were able to achieve full marks for this question.

Question 10

Approximately one quarter of candidates attempted this question. In general the use of conservation of momentum and restitution was completed well by candidates, including in the case of the series of collisions. Part (i) was generally well answered, and many candidates were able to give at least a partial explanation of the result in part (ii).

Part (iii) caused considerably greater problems for many candidates, who struggled to identify the infinite series in order to evaluate the sum. Those who did successfully complete part (iii) were often able to complete part (iv) as well.

Question 11

While this question had the smallest number of attempts among the Mechanics questions, it did have the highest average mark. Many candidates were able to produce a diagram with the appropriate forces labelled and realised that the usual procedures of resolving in two directions and taking moments about a point would be a sensible approach. Despite the hint that taking moments about the midpoint of the rod might be helpful, a number of candidates chose to take moments about one of the ends of the rod, which led to more complicated sets of equations to solve.

The manipulation of the trigonometric terms proved challenging for many candidates, but a number did manage to work through to a clear and full solution to the problem.

Question 12

This was the second least popular question on the paper and many attempts only secured a small number of marks. Many of the candidates who attempted the question were able to form an appropriate expression for the expected profit, although a small number of solutions used the approximation too early and so did not give exact expressions at the points where they were required.

For the second part of the question the relationship between the three new variables was often found successfully and many of the candidates who attempted this part of the question were able to make progress towards the expected profit. A small number of candidates were able to follow through the final example to reach the required deduction.

Question 13

This was the least popular question on the paper and the only one where no candidate achieved full marks. Many candidates struggled to explain how the given situation could be described by the recurrence relations given. The elimination of t from the recurrence relations also proved problematic for many of the candidates. A few candidates were however able to show the solution for the sequence s and deduce the correct expression for the sequence t.