CAMBRIDGE ASSESSMENT

STEP Examiners' Report 2010

Mathematics
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TEST

STEP Mathematics III 2010: Report

About 80% of candidates attempted at least five questions, and well less than 20% made genuine attempts at more than six. Those attempting more than six questions fell into three camps which were those weak candidates who made very little progress on any question, those with four or five fair solutions casting about for a sixth, and those strong candidates that either attempted 7^{th} or even 8^{th} questions as an "insurance policy" against a solution that seemed strong but wasn't, or else for entertainment!

Section A: Pure Mathematics

1. This was a very popular question, and the first two parts usually scored full marks. The expression of D in part (iii) caused some problems with inaccurate algebra which then made the last two results unobtainable. Those that simplified D most neatly were in a stronger position to finish the question, though "if and only if" was frequently ignored, or only lip-service was paid to it. Consequently, scores were well-spread.

2. The most popular question, the scoring rate was very similar to the first. Quite a few candidates did not take the hint provided in part (i) to express cosh a in terms of exponentials in order to perform the integration. However, apart from those that did not correctly substantiate the given result, many handled the partial fractions and exponentials well, and quite a number dealt with the infinite limit impressively. Problems arose later in the question with manipulating logarithms and the instruction to express answers in terms of hyperbolic functions was either overlooked or beyond their capacity.

3. Just over half the candidates attempted this question with most scores being quarter, half or three quarters in equal shares. Most candidates understood the idea of the question, the definition of a primitive root, and many wrote the roots of unity in (modulus) -argument form or exponential form. Failure to present a logical argument in parts (ii) and (iv) was a common problem and $C_6(x)$ tripped up quite a few.

4. This was a popular question, though it was not generally well scored upon, with very few candidates earning full marks. Most began strongly, and finished by finding the values of b correctly. However, basic sign errors did prevent some from achieving the numerical pay-off. Part (ii) was, as expected, found trickier than part (i). Overall, the non-triviality of "if and only if" was rarely addressed as an issue in either part.

5. This question resembled question 3 in popularity and success. Most were able to derive line equations reliably, and address the intersection problem. (Those that used an equally valid vector formulism had a low success rate for no apparent reason.) Very few addressed whether or not factors that were being divided by were non-zero. Mistaking m for n and vice versa, careless algebraic errors, and overlooking which equation represented which line caused problems in trying to find T. The idea of explaining the construction verbally in the last part exposed that many candidates are not used to expressing a formal argument in words. The nicety of this question is that whilst all candidates will have encountered geometrical constructions involving straight edge and compass, few will have previously met one that only requires a straight edge.

6. About a tenth of the candidates attempted this, with less success than nearly all other questions on the paper. Part (i) caused few problems, but at some point in part (ii), errors were frequently made or lack of attention to which of the two angles in parts (i) and (ii) was being employed in which rotation, and so even those few that knew how to attempt part (iii) were thwarted.

7. Just over 60% attempted this question, achieving moderate success. The opening result was well done, but the two similar equations foundered frequently on incorrect differentiation. If these two were correctly obtained, then the conjecture and induction were usually correct. Appreciating that the final expression was actually a polynomial, and what this entails, passed most by.

8. Three quarters of the candidates had a go at this, with moderate success. Most understood the method intended for part (i) and were aware of the method of using an integrating factor. Algebraic slips led to incorrect simultaneous equations in part (i), and few dealt with the non-uniqueness of R(x) satisfactorily. Having found the integrating factor for part (ii), most did not proceed further. Some candidates introduced a sign error into part (ii) which trivialized the left hand side to a differential of a product. A small number of candidates produced elegant solutions to part (ii) using the tan half angle substitution.

Section B: Mechanics

9. Less than a fifth of the candidates attempted this, though it was the most popular of the non-Pure questions. Candidates were largely fairly successful or struggled to get started. Some of those failing to get anywhere equated the normal reaction on P to the component of P's weight, completely ignoring the radial acceleration, and others got the sign of the force wrong. Nearly every candidate failed to justify imposing the non-negative condition on the normal reaction when $\theta = \frac{\pi}{2}$.

10. Only 5% of the candidates attempted this and it was another case of nearly all or nothing. Even the mostly successful candidates rarely handled the small oscillation algebraic manipulation correctly, often overlooking using the small angle result throughout the expression, so very few obtained the correct period though the principle was understood.

11. Slightly fewer attempted this than question 9, and this question was least well scored upon of any on the paper. Generally, candidates got through part (i) successfully and then either gave up or got right through the question. Common errors were the misapplication of conservation of momentum, failure to distinguish directions which led to negative signs which were then mis-handled to obtain the quoted answer in (i), and even strong candidates failing to appreciate that acceleration was constant making the later parts all susceptible to constant acceleration formulae and thus not requiring less direct approaches. The brief description at the end was usually restricted to only trivially considering the block, and few gave any thought to the bullet.

Section C: Probability and Statistics

12. Although this was marginally less popular than question 11, the success achieved was similar to that on the first two questions. A small number of candidates didn't get started but most found the first parts straightforward and dealt with the manipulation and summation of the geometric series correctly. Many found an incorrect "shortcut" on the last part, despite having a good idea how to attempt it correctly having completed the earlier parts.

13. This was the least popular question with little more than a couple of handfuls of attempts. In view of the small number of attempts, there were no detectable trends though oddly, the very few candidates who mastered this question conspired to avoid full marks by making minor algebraic inaccuracies having dealt with all the trickier aspects.