9465 – Mathematics I

General comments

This paper was found to be more difficult than last year's; somewhat worryingly, this was perhaps because the paper placed a greater emphasis on algebraic and numerical manipulation than previously. At this level, the fluent, confident and correct handling of mathematical symbols (and numbers) is necessary and is expected; many good starts to questions soon became unstuck after a simple slip. The applied questions appeared to be beyond many candidates; it has been suggested that this reflects the reduction of the amount of applied mathematics in single maths A-level.

There were of course some excellent scripts, but the examiners were left with the overall feeling that some candidates were not ready to sit the examination. The use of past papers to ensure adequate preparation is strongly recommended. A student's first exposure to STEP questions can be a daunting, demanding experience; it is a shame if that takes place during a public examination on which so much rides.

Comments on individual questions

1 Some candidates could not square correctly a three digit number; of those who did, not all recognised that $184^2 - 33127 = 27^2$. This was intended to be a straightforward "warm-up" question, but it was not to be found to be so.

2 The key word in this question was "prove", but most candidates *assumed* that the goat would graze the maximum area if it were tethered to a corner of the barn, and the minimum if tethered to the middle of a side. This unjustified assumption severely reduced the awarded marks. Candidates are advised to ensure they understand what, at this level, is required by an instruction to *prove* a result.

3 Parts (i) and (ii) were reasonably well done, but very few successful attempts to (iii) were seen. Most candidates had not realised that they were supposed to be thinking about the graph of $y = x^3 + px + q$, in particular its stationary points and its y-intercept.

4 The two graphs were well drawn, although sometimes the horizontal scale was in degrees. The area formula was often derived correctly, but the subsequent differentiation often contained a major error, most commonly a failure to apply the chain rule when differentiating $\tan(\square / n)$. Most candidates found it hard to construct a coherent argument (using part (ii)) about the ratio of the polygon to the circumcircle.

5 This integration question was tackled much more successfully than last year's. It was particularly pleasing to see how many candidates were able to cope with the unusual partial fractions that arise in part (ii); some imaginative methods were seen.

6 This was a popular, straightforward question, which was often answered very well. However, algebraic errors still occurred – even when expanding $(3a + 4b)^2$.

7 Only a few candidates saw the connection between the two halves of part (i), and therefore most evaluations of the definite integral failed to remove the modulus of the integrand correctly. Interestingly, part (ii) was often found more straightforward.

8 This was a well-answered question (using either vectors or the cosine rule), although some candidates tried to derive the result about d by using the vector equation of the plane ABC: the instruction "hence" required the use of the first two parts of the question. Candidates should ensure that they understand the distinction between "hence" and "hence or otherwise".

9 It was not thought that this would be a difficult question, but many candidates were unable to model correctly the motion of three connected particles. A common error was to consider $xg - yg$, the resultant force acting on the whole system, but to divide it by $x + y$ rather than $x + y + 4$ when calculating the acceleration.

10 Very few attempts at this question were seen, and those that did rarely progressed beyond the first paragraph.

11 Hardly any attempts at this question were seen, but those candidates who did tackle it were usually able to produce a mostly accurate solution. It was remarkable how few diagrams, not to mention labelled diagrams, were seen: it is always much easier for both the candidate and the examiner if symbols are clearly defined in a diagram.

12 Many different (and correct) arguments were seen to the first part: candidates' careful analysis of the different possibilities was encouraging. Unfortunately, hardly any candidates recognised that the second part of the question was asking for a conditional probability. This prompted the examiners' concern that candidates were too reliant on a verbal clue such as "given that", and found it very hard to identify the inherently conditional structure of an event such as was described in this question.

13 Very few attempts at this question were seen, although it was not expected to be popular since it was known that some candidates would not have studied the Poisson distribution. However, knowledge of it (and the Normal distribution) remains in the published specification, and so candidates may wish to ensure that they are familiar with both of these.

14 Part (i) was well answered by most of those who attempted it. Solutions to part (ii) often began with a correct product of fractions, but it was surprising how often factorials were employed in an (unsuccessful) attempt to simplify an expression that cancelled down very easily to $1/(n + 1)$. The implicit fact that n + 1 $\geq r$ was not often realised, leading to "$n = 0$" as the modal answer.