9465 - Mathematics 1

General comments

This paper was found to be more straightforward than last year's, with the exception of the questions on Probability and Statistics. The Mechanics questions (in particular, 9 and 10) were more popular than previously. Inaccurate algebraic manipulation remains the biggest obstacle to candidates' success: at this level, the fluent, confident and correct handling of mathematical symbols is necessary and is expected. Many good starts to questions soon became unstuck after a simple slip. There was little evidence that candidates were prepared to check their working, doing so would have improved many candidates' overall mark.

The weakness of many candidates' integration was striking, and somewhat alarming.

Comments on specific questions

1 This was a popular question, and most candidates were familiar with the underlying principle that, if there are n symbols of which a are of one type and b are of another type etc, then there are $n! \div (a! \times b! \times \ldots)$ distinct rearrangements of the n symbols. It was important to enumerate systematically the combinations totalling 39, to avoid counting possibilities more than once.

2 This was a popular question, but was one which required careful algebraic manipulation. It was pleasing that most candidates saw how to use the statement that "(1, 0) lies on the line PQ" to deduce that $pq = -1$. Proving that $PSQR$ was a rectangle was rarely done in full: most candidates proved necessary conditions (e.g. there were two interior right angles) rather than sufficient conditions (e.g. there were three interior right angles in a quadrilateral, hence there were four). Considering the lengths of the sides without considering at least one interior angle did not remove the possibility that the quadrilateral was a (non-rectangular) parallelogram.

3 Most candidates who tackled this question knew what to do, but did not express clearly the necessary reasoning. In part (i) the solution "$x = \sqrt{ab}$ or $x = -\sqrt{ab}$" did not show that the given equation had "two distinct real solutions"; there was needed an explicit statement that since a and b were either both positive or both negative then $ab > 0$, hence $\sqrt{ab}$ was real. Similarly, in part (ii) most candidates did not explain why $c^2 \neq 0$.

In such questions, candidates are reminded of the need to explain clearly each component of the result they have been given.

4 Part (a) was usually well done, though quite a few candidates did not justify the negative value of $\sin\theta$. Arithmetical errors marred many evaluations of $\cos 3\theta$. The given identity was not found difficult to prove, and most candidates saw that in part (b) they were being asked to solve $2x^3 - 33x^2 - 6x + 11 = 0$. Unfortunately, very few were able to make further progress: substituting (correctly) $x = ½$ was rarely seen. Most of those who made progress remembered to explain which of the three values of x was the value of $\tan\theta$.

5 Neither integral in this question was at all difficult, so it caused some concern to see poor implementation of routine techniques such as integration by substitution or by parts. In part (i) not every candidate linked the two cases together. In part (ii) $m = 0$ was often asserted to be a special case before the integration had been performed. Even after that, the terms m +

1 and $m + 2$ in the denominator of the answer did not always prompt candidates to consider $m = -1$ and also $m = -2$ as special cases.

6 Part (i) was well done. Those who attempted part (ii) derived the appropriate equations, but then found it hard to proceed: a common error was to assert that if $ax^2 + bx + cy^2 = d$ was to be the same as $x^2 + 14x + y^2 = 51$, then $a = 1$, $b = 14$, $c = 1$ and $d = 51$, rather than the correct deduction that $b \div a = 14$, $c \div a = 1$ and $d \div a = 51$.

7 This was not a popular question, though part (i) was usually well done. Part (ii) required the factorisation of $r^2 - 1$, and those who saw this usually simplified the product. Very few solutions to part (iii) were seen: the replacing of cot θ with cos $\theta \div$ sin θ and the simplification of the two terms into a single fraction was very rarely seen. Those who reached this stage did not all recognise that $\cos A \sin B + \cos B \sin A$ can be simplified further.

8 Most candidates who attempted this question did so confidently and largely successfully. It was pleasing to see that they understood how to use the hint implicit in the first result they derived. However, a lot of solutions were flawed by the omission of the constant of integration.

9 Many candidates attempted this question, and made good progress. Commonly seen was the incorrect statement that $\frac{1}{2} T \sin \theta = \mu R$ (derived by resolving horizontally on the rod). There was no statement in the question that the rod was about to slip, hence it was wrong to assert that the frictional force equalled μR. Full marks were not awarded unless the candidate was careful to state that $F \leq \mu R$.

10 This was the most popular Mechanics question, and was often well done. Clearly labelled diagrams would have helped both candidates and examiners. Candidates are encouraged to simplify answers as fully as possible: the results in parts (i) and (ii) were not always reduced to their simplest forms. It was not necessary to do so to achieve full marks, but at this level candidates should expect to give answers as neatly as possible.

11 The Mechanics tested by this question was not demanding, but candidates found that solving the resulting equations was taxing. Great care was needed in part (iii). Many solutions began "$\mathbf{v} = \mathrm{k}\mathbf{r}$ so $2 \cos 2t = \mathrm{k} \times \sin 2t$, and $-2 \sin t = \mathrm{k} \times 2 \cos t$". The subsequent deduction that $2 \cot 2t = \mathrm{k} = -\tan t$ should not have been made, without considering whether $\sin 2t$ or $\cos t$ equalled zero.

12 This question was very poorly answered. In part (a) almost every candidate assumed that hat-wearing and pipe-smoking were independent, and so multiplied together the given probabilities. A handful of attempts at part (b) were seen. It was intended that this question be tackled with Venn diagrams rather than tree diagrams: candidates seemed utterly unfamiliar with these.

13 Very few attempts at this question were seen, which was surprising since, with the aid of sketch graphs and a tree diagram, it was probably a lot more straightforward than question 12.

14 No successful attempts at this question were seen. Those who started it usually failed to realise that they had been given the cumulative distribution function rather than the probability density function.