**Comments on individual questions**

**Q1**

This was a popular question and most candidates managed to find expressions for $p$ and $q$ easily. Many did not make any progress beyond this point however. Of those that continued with the question many managed to find the minimum value of $p+q$ easily, but the minimum value of $\sqrt{p^2+q^2}$ caused more trouble. The majority of candidates did not realise that they could simply differentiate $p^2+q^2$ to find the minimum value and so attempted a more complicated differentiation. In many cases they were successful, but then failed to find the value of $m$ to complete the question.

**Q2**

This was again a popular question with candidates achieving varying levels of success. The first part of the question was generally well attempted, although a number of candidates who identified that the equation could be rewritten as $y=(x^2-3)^2$ assumed that this would result in a sharp change of gradient at the points of intersection with the $x$ -axis (as would be seen in the graph of $y=|x^2-3|$).

Some candidates attempted to regard the equation as a quadratic in $x^2$ to identify the number of roots for different cases, but this did not sufficiently distinguish between the different cases in the solutions provided. A better method is to consider the intersections of two graphs as the value of $b$ is varied. Another common mistake was to give just part of the solution set in the case $n=2$ or to assume that it is not possible for there to be three solutions.

In the second part of the question most candidates correctly found the two possible values of $a$ , but often just chose one of the values to work with for the next part. Graphically, the difference between the two cases is a reflection in the $y$ -axis and, since the intersections with a horizontal line are being found, the sets of values of $b$ will be the same in both cases. This was not explained in choices that decided to explore just one of the two cases.

**Q3**

The first part of this question was generally well answered by those candidates who recognised the concept of placing the required area between two triangles. There were a number of answers where the graph was sketched, but no further progress was made however.

Of those who solved the first part of the question, many were able to do some work on the second part of the question, but took the upper limit of the integral as $x=a$ (consistent with the method for the first part of the question, but not required here as $x=1$ is the upper limit to choose) and therefore arrived at far more complicated expressions than were needed. Often this led to a doomed attempt to handle the algebra that was left.

For those who correctly chose the limits of the integration the part of the inequality whose solution involved $(\ln \alpha)^2$ still proved a challenge for some.

**Q4**

This question was generally well attempted, with many candidates able to obtain the equations of the tangents and normals. The point of intersection of the tangents did not cause too much difficulty, but the intersection of the normal was problematic for many candidates who struggled to simplify the expressions and therefore did not reach a point where it was obvious that the point lay on the line $y = x$ .

The final part of the question is much easier if the expressions are simplified as they are encountered and for this the factorisation of the difference of two cubes is a useful thing to know. It is also useful to realise that the information that $2pq = 1$ means that the expression $p^2 + q^2 + 1$ can be factorised as $(p + q)^2$.

**Q5**

This was another popular question, with attempts by a large number of candidates. Integration by parts was required for both of the main methods for the first integral, either preceded or followed by the application of some trigonometric identities. A number of candidates managed to obtain the correct answers for each of the first two integrals, but then struggled to relate them to the final part of the question, in some cases ignoring the different limits and in others incorrectly manipulating the logarithms.

**Q6**

This question was not attempted by many candidates, possibly due to the apparent three-dimensional nature of the problem (although it reduces to a two-dimensional problem immediately). Many candidates solved the first part of the problem through applications of Pythagoras theorem in the various right-angled triangles that can be identified rather than using the similarity that is present. A number of candidates got the expressions for the tangent and cotangent confused.

Where candidates attempted the second part they were generally more successful, although care needed to be taken over the individual steps. Relating the identity to the first part of the question involved an understanding of the trigonometric graphs and this was done successfully by a number of candidates.

**Q7**

The first two parts of this question were generally well answered, although a number of candidates were confused about the order in which to substitute the variables into the equation and thus got answers with $p$ and $q$ confused. The third part proved more complex, with the factorisation of the final expression causing problems for some candidates.

**Q8**

This was a very popular question with attempts by most of the candidates. In many cases the first substitution was correctly carried out and the resulting differential equation solved, but then no progress was made on the second part.

The candidates who realised that the same substitution would work for the second part managed to get to the reduced differential equation. Although the integration for this differential equation was more complicated, many of the candidates who reached this stage managed to evaluate the integral (although sometimes by longer methods than were needed).

**Q9**

This question was quite popular. The first part of the question involves the application of the formulae for motion under uniform acceleration and this was generally well carried out, although a number of candidates did not justify the choice of the positive square root. A number of candidates also took a longer approach to the calculation, calculating the time to reach the highest point and then the time for the downward journey. Many candidates realised that differentiation of the expression for the range was required, although some decided to differentiate with respect to $\theta$ , rather than $c$ , making the task more difficult. The differentiation requires a degree of care to make sure that the signs are correctly managed and many candidates did manage to complete this successfully.

**Q10**

For many candidates the first part of the question was solved correctly. The manipulation of the expressions involving sums and differences of square roots was more complicated for a number of candidates and the derivation of the formula required in the second part was less successfully carried out. The final part of the question involved the substitution of the values given into the formula, and providing that this was done with care the correct answer was generally found successfully.

**Q11**

This question began with some quite familiar calculations involving inclined planes and many candidates who attempted the question were able to reach the solution. In some cases the required value of $M$ was assumed rather than solving the simultaneous equations.

The second part of the question was less familiar and some candidates did not realise that the fact that the pulley can move means that there will be different accelerations at different points in the system. They therefore attempted to calculate one value for the acceleration that worked for all of their equations.

**Q12**

This question was not attempted by many candidates. In some cases it was not understood that the function had to be integrated to find the probabilities. The identification of the probabilities required for the conditional probability calculation was also problematic. Where it was there were some good answers, although the algebraic manipulation proved a little complicated for some candidates.

**Q13**

This question was not attempted by many candidates. There were some good answers showing a clear thought process to reach the required value, but many of the other solutions offered suffered from a lack of explanation of the method meaning that the ideas being applied were difficult to follow.