Examiners' Report/ Principal Examiner Feedback

January 2010

GCE O Level

Pure Mathematics (7362/02) Paper 2

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Pure Mathematics

Specification 7362

Introduction

Candidates found paper 1 to be slightly more difficult than paper 2 although both papers contained some questions where the weaker candidates could gain marks and also questions to challenge the most able. There was no evidence that candidates were prevented from showing what they could achieve due to lack of time.

There were the usual problems of failure to round answers as instructed and failure to carry sufficient significant figures through the working to enable accurate final answers to be obtained. Several of the questions demanded exact answers. Candidates should be advised that whenever that is the case use of a calculator to obtain decimal approximations on the way to the answer causes loss of exactness and the final mark is already lost. Also, candidates at this level should be aware of the two units of angle measurement and take care to set their calculators to the correct mode in any trigonometric question.

Whenever a formula is used it is advisable to quote that formula first. That way if an error is made when numbers are substituted the examiner can see clearly that the candidate knows the correct method (so method marks are available) but has made a slip (and so accuracy marks are lost). Without the formula shown, incorrect substitution will be assumed to be an incorrect formula. Examiners can only mark what the candidate has written on the examination paper – they cannot read candidates' minds.

Paper 2

Report on Individual Questions

Question 1

Most candidates knew the product rule was needed here and could apply it successfully. Errors occurred in manipulating the coefficients; some candidates divided rather than multiplying or missed them out altogether. There were also some sign errors.

Question 2

Candidates generally realised that they needed the cosine rule in part (a), but not all could place the given lengths in the correct positions to obtain the required angle. Many candidates were unable to round 39.97… correctly to three significant figures – 39.9 and 37 were often seen.

Question 3

Some of the answers to part (a) suggested that candidates did not understand the word "equation" as 3 and $y \neq 3$ were offered instead of $y = 3$. The success rate in part (b) was much higher, with some candidates scoring their only marks for the question here. In part (c), many candidates were aware of the shape of the graph from this type of equation, but some were unable to place their curves in the correct quadrants or only drew one portion of the curve. Others did not appear to know what an asymptote is as their curves crossed one or both of these; in such cases the mark for drawing the asymptote is lost as the lines are no longer asymptotes. Another very common error was to fail to indicate the coordinates of the points where the curve crossed the coordinate axes.

Question 4

The table of values in part (a) was usually completed correctly but some answers were not rounded as demanded. Many candidates drew acceptable graphs and gained both marks but it was not uncommon to see the point $(0.5, 0.649)$ plotted below the *x*-axis. This produced a somewhat odd shaped curve which should have alerted the candidate to the error. Between $x = 3$ and $x = 3.5$ some drew the "curve" with a straight line parallel to the *x*-axis. There was no need to find the coordinates of the minimum point but an appreciation of this minimum being somewhere below the line joining the points where $x = 3$ and $x = 3.5$ was expected. Part (c) saw many candidates who essentially knew what to do but could not correctly multiply through by 4 – they forgot to multiply the 2. Other candidates could not undo the logarithm correctly in (c) (ii). Again, there were candidates who did not give their estimates to the required degree of accuracy.

Question 5

Most candidates could obtain $t = 3$ and $t = 4$ but some differentiated first. The graph caused problems as some did not realise it was a cubic graph and either ignored their results from (a) or drew the sketch with a straight line along the *t*-axis between $t = 3$ and $t = 4$. Even those who drew an acceptable sketch rarely realised that it was intended to assist them with the solution to part (c). It was very common to see candidates evaluate $\int_0^4 v\,\mathrm{d}t$ and so gain only the second method mark here. Those who did realise that two integrals were needed were almost all able to reach the correct answer although some added their integrals instead of subtracting.

Question 6

Although many candidates were able to set up two correct equations from the information given in part (a), solving those equations proved more challenging. There were many algebraic errors made and even those who arrived at $r^4 = \frac{1}{16}$ frequently forgot that the fourth root could be negative as well as positive. The question provided a hint here as "possible values" were demanded. In part (b) some interpreted the phrase "greater than 100*x*" as meaning that an inequality was required rather than being a means of making a decision as to which value of *r* to use or which value of *a* to choose. Those who attempted part (c) could, in general, set up an appropriate equation and solve it for *x*. However, those who had omitted the minus sign at the end of part (a) were working with an incorrect value for *r* so could not get the correct answers for either (b) or (c).

Question 7

Almost all candidates knew that to start this question they needed to eliminate *y* between the two equations. However, weaker candidates did not know how to proceed with the resulting equation. Squaring e^{2x} to obtain e^{4x} rather than leaving it as $(e^{2x})^2$ caused some candidates to flounder; others substituted another letter for e^{2x} to make a more user friendly quadratic. Unfortunately they often choose *x* or *y* and then thought they had reached the final answer before they had reversed their substitution. In a question such as this accuracy is preferred, but not demanded, so $x = \ln 3$ was accepted as was its decimal version of 1.1. However, the accurate corresponding value of *y* was 36. 1.1 was a rounded answer and more figures should have been used to obtain *y*, so 36.1 was not accepted. Some candidates thought that the solution to $e^{2x} = 1$ was $x = 1$.

Candidates who obtained the coordinates of *A* and *B* (correct or otherwise) could attempt the length of *AB* but incorrect coordinates could not yield a correct answer for part (b). In part (c) the determinant method of finding the area of a polygon was the most frequently seen and, with the correct coordinates, usually gave the correct answer. A few candidates used much longer methods. Having found the length of one side of the triangle they proceeded to find the other two lengths and then either used the cosine rule to find an angle, followed by $\text{area} = \frac{1}{2}ab\sin C$ (had they not noticed that this method, with all the sides given, was worth 6 marks in question 2 but only 4 here?) or used $\text{area} = \sqrt{s(s-a)(s-b)(s-c)}$.

Question 8

There were a significant number of candidates who avoided attempting part (a) at all. Of those who did, many did not set out their working clearly, or made double errors in order to arrive at the given answer. In part (b) most candidates were able to differentiate and obtain a correct value for *r* although a minority did not round as instructed. The differentiation in part (c) was more difficult and some errors arose. Although a correct conclusion could be drawn from an incorrect differential, not all the marks for this section can be gained. As the question told candidates that their answer from (b) should yield a minimum value for *A* it was an essential part of the work in part (c) to demonstrate why this was so. It was therefore necessary to show that $\frac{\mathrm{d}^2A}{\mathrm{d}r^2}$ was positive when $r = 2.71$; many candidates failed to do this. Most candidates used a correct method in part (d) and, providing they had a correct value for *r*, calculated the correct minimum value of the surface area. A few however, seemed to think that the value of $\frac{\mathrm{d}^2A}{\mathrm{d}r^2}$ that they had obtained in part (c) was the minimum value of *A*.

Question 9

The majority knew to multiply out the brackets in the left-hand sides of the identities in part (a) but some made sign errors, particularly in the second one. The middle terms can never totally vanish if three are positive and only one is negative. Some candidates failed to appreciate that the identities in part (a) had been provided to assist them in the following work. Algebraic errors aplenty were seen in parts (b), (c) and (d). Most gained the mark for $\alpha + \beta = -7, \alpha\beta = 3$ in part (b) but some then gained very little more until they arrived at part (e). Many ignored the requirement for an exact value in part (d) and used a decimal approximation for $\sqrt{37}$ (or their answer for part (c)). Candidates seemed familiar with the method of constructing a quadratic equation with given roots although some thought they needed +sum of the roots$\times x$. Finding that sum challenged some candidates; it was not uncommon to see $\frac{\alpha}{\beta^2} + \frac{\beta}{\alpha^2} = \frac{\alpha^3 + \beta^3}{\beta^2 + \alpha^2}$. The most common errors here, however, were to fail to give an equation by omitting the $= 0$ or to forget to move from fractional to integer coefficients.

Question 10

Candidates were usually able to pick up the hint provided in part (a) and wrote $\tan(A+B)=\dfrac{\sin A\cos B+\cos A\sin B}{\cos A\cos B-\sin A\sin B}$ but the majority were not able to proceed further. Some candidates worked successfully from $\dfrac{\tan A+\tan B}{1-\tan A\tan B}$ to $\tan(A+B)$. In part (b) many candidates substituted inappropriate values (such as 15 and 60) for *A* and *B* or simply used a calculator. It was evident that many had not seen this type of question before. The two tangents requested in part (b) were reciprocals of each other as the angles were complementary. It was exceedingly rare to see a candidate who was aware of that. The successful candidates in part (b) used 30 + 45 for 75 and either 60 – 45 or 45 – 30 for 15. Part (c) provided an easy mark for all those who read that far through the question but part (d) proved to be particularly challenging. It was a very able candidate who realised that part (c) was a hint for part (d) and writing $\theta = 22.5°$ might lead to a solution. Those who did usually managed to solve the resulting quadratic equation and identify the required value on the basis of the angle being acute. Some, unfortunately, having made the connection with part (c), then failed to use $\tan 45° = 1$ to obtain the equation. Part (e) was answered in one of two legitimate ways; use of a calculator to obtain θ and doubling before finding $\sin 2\theta$ was not legitimate. This calculator method lost accuracy and so could not provide an exact answer. Both legitimate methods required the use of Pythagoras and one of the given identities. $\text{Sin}\,\theta$ and $\cos\theta$ could be obtained from the given value of $\tan\theta$ and then $\sin 2\theta$ could be obtained by use of $\sin(A+B)=\sin A\cos B+\cos A\sin B$ or $\tan 2\theta$ could be obtained from $\tan 2\theta=\dfrac{2\tan\theta}{1-\tan^2\theta}$ and then Pythagoras used to obtain $\sin 2\theta$.

Statistics

Overall Subject Grade Boundaries

Grade	Max. Mark	A	B	C	D	E	U
Overall subject grade boundaries	100	72	55	39	34	29	0

Paper 1

Grade	Max. Mark	A	B	C	D	E	U
Paper 1 grade boundaries	100	70	54	39	34	29	0

Paper 2

Grade	Max. Mark	A	B	C	D	E	U
Paper 2 grade boundaries	100	73	56	39	34	29	0

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