Examiners' Report Summer 2009

GCE

GCE AO Level Pure Mathematics (7362)

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Introduction

Candidates found paper 2 considerably harder than paper 1, probably because of Q7, Q8(a) and Q10. Marks were lost throughout both papers by using degrees where radians were required, failing to round as instructed and using previously rounded answers for following work.

Candidates working at this level should appreciate that to obtain answers to, eg, 3 significant figures, all the working needs to be carried out using numbers with more significant figures (except where they are exact). There is also a tendency to use calculators without showing all the steps in the working. Whilst this is not a great problem if correct answers are obtained, when the answers are incorrect no method marks can be awarded if the method is not shown clearly. Another example of this is that when limits are substituted in the result of an integration and the actual substitution is not shown it is not always possible to give the method mark unless the final answer is correct.

There were still cases of candidates who needed extra space for a question using blank pages or surplus space intended for a different question and not clearly indicating this had been done. Blank pages are only seen by an examiner if the examiner requests them; otherwise, they are not looked at. Using blank pages is therefore a very risky practice; an extra sheet of paper should be requested instead.

Paper 1

Report on Individual Questions

Question 1

Most candidates found this to be a good opening question. The factor theorem was applied successfully by the majority, only careless errors resulting in a final answer of 5 instead of –5 preventing full marks from being gained.

Question 2

Another good question which allowed even the weakest candidates to gain some marks. Most could undo the logarithm and solve the resulting equation. The most common error was to use 4^5 instead of 5^4.

Question 3

Many good responses were seen here too. The majority were able to find one of the vectors $\pm\overrightarrow{\mathbf{OE}}$ or $\pm\overrightarrow{\mathbf{EF}}$ but the subsequent comparison with $\overrightarrow{\mathbf{OF}}$ and the required conclusion were not always seen explicitly.

Question 4

The better candidates found this a straightforward question on this topic. Some candidates failed to realise that $\delta r = \frac{r}{100}$ or forgot to divide δA by A. In some cases δA and δr were never seen, causing loss of the final A mark. Weak candidates often knew differentiation was required and so found $\frac{\mathrm{d}A}{\mathrm{d}r}$, but did not know what to do with their differential. Candidates who adopted the algebraic method rather than employing calculus were usually successful.

Question 5

In part (a), some found the mid-point of AB instead of the coordinates of the required point leading to gradients in part (b) which did not have a product of –1. The demand for an equation of a perpendicular in part (c) led many to find the equation of the perpendicular bisector of AB rather than the perpendicular through A. Some final answers were not given with integer coefficients.

Question 6

Most candidates achieved full marks for part (a) but part (b) was more problematic. The expression for the acceleration was usually correct but then many equated it to zero instead of substituting a value of t. Of those who substituted, many did not like the fraction answer from (a) and substituted 3 instead; some clearly did not know which value of t to choose and so substituted both in turn. Some candidates did not like the negative answer and so lost their minus sign for the final line. Provided the correct answer of –28 had been seen this could be ignored, but without the correct answer shown candidates lost the final mark.

Question 7

Some real misunderstanding was evident in part (a) with many candidates using the sum formula instead of the nth term formula to set up their equations. Solving the equations once they were set up was not a problem. Part (b) caused many problems. It was more common to see the sum of the 11th to 25th terms found than the demanded 10th to 25th. A few candidates, having first established the number of terms in the sum that they were to find, proceeded to find the sum of the first 15 or 16 terms.

Question 8

A minority of candidates failed to read the question carefully enough and so included the top of the box in their surface area. They usually arrived at the given result but by erroneous methods. In part (b) errors appeared in the removal of the brackets, where $\frac{9x^2}{8}$ appeared instead of $\frac{9x^3}{8}$. Many candidates used the product rule to differentiate, thereby avoiding this potential error. Most went on to solve $\frac{\mathrm{d}V}{\mathrm{d}x} = 0$ but some then used the negative (impossible) value of x to find V, possibly because they had the maximum value in mind and knew negatives were relevant! Many thought they needed to justify the maximum but this question did not demand that so they wasted valuable time.

Question 9

Part (a) was answered well by a majority of candidates although some failed to round their answers as instructed or used a previously rounded answer in a following calculation, thus compromising accuracy. Candidates should, however, be warned that using the sine rule to find the *largest* angle of a triangle is risky as they could be working with an ambiguous case; using the cosine rule wherever possible is simple with a calculator and avoids this problem. A surprising number used the sine or cosine rule to obtain their third angle instead of the quicker method of using the angle sum of a triangle. In part (b), many candidates could not use simple geometry to obtain the angles they required in order to proceed. Some candidates invented right-angles triangles in order to do this part and many made no attempt at all.

Question 10

Most candidates could attempt to solve the equation in part (a) but far too many either divided by sin x instead of factorising, thereby losing an answer, or gave their answers in degrees. The differentiation in part (b) was either attempted well by the product rule or left blank. However, very few spotted that it was quicker to substitute $x = \frac{\pi}{3}$ in their expression for $\frac{dy}{dx}$ than to solve the equation $\frac{dy}{dx} = 0$. Only a few candidates established the maximum at $x = \frac{\pi}{3}$ by considering the sign of the second differential (the majority lost those 2 marks) and many omitted to obtain the corresponding value of y.

Question 11

Part (a) was usually done well using the quotient rule and the Pythagoras identity. However, there was still a small minority who quoted the known result $\frac{d}{dx}(\tan\theta) = \sec^2\theta$ and so scored zero on this part. Most candidates could write down the coordinates of A as required in part (b) but many only gave one correct answer in (b) or gave their answers in degrees. In part (d) many differentiated once more instead of using the given result in (a). Often they made errors this time! Those who managed to find an equation of the normal at D could proceed to find the x-coordinate of G but several obtained a decimal answer. They were clearly aware of the meaning of "exact" as they transformed their decimal to a fraction. However, once exactness has been lost it cannot be regained. Part (e) challenged even the best of candidates. Very few made use of their diagrams to add the normal at D and consider what was being asked.

Question 12

Most candidates know and can apply the binomial expansion and simplify their results. However marks were lost in parts (a) and (b) by those who did not simplify far enough. These errors are strange as most calculators will do this job easily now. Relatively few candidates seem to know the condition for convergence of these series and so scored zero in both of parts (c) and (e). For part (d) many knew they had to multiply the two expansions obtained in (a) and (b) but many failed to eliminate the 2s correctly or just changed x to y instead of to $3y$ or made both errors. The integration in part (f) was performed well by those who had obtained a series expansion (correct or otherwise) in part (d). However, many candidates had the quotient of two expressions and integrated each expression separately to obtain another quotient.

Paper 2

Report on Individual Questions

Question 1

There were many fully correct solutions to this question. The majority of candidates realised that the discriminant was the key and formed a correct quadratic inequality. Most obtained the correct critical values but mistakes were made interpreting these or through having an incorrect inequality.

Question 2

Most candidates scored full marks on this question. Algebraic errors in solving the quadratic, usually in y but sometimes in x resulted in a loss of marks and a few candidates made mistakes when finding the second coordinates.

Question 3

Many candidates gained full marks on this question too. However a disappointingly large number could not sketch the line $y = 3x + 8$; some attempts even had negative gradients. Sketching $x = 3$ defeated some. The most common error was to shade the wrong region.

Question 4

As usual some candidates required a lot of working to arrive at answers for part (a) and some gave inequations or just numbers instead of equations for their answers. Most marks were lost in part (c), where graphs had only one branch or the coordinates of the intercepts were not added to the diagram. Some candidates could not draw a sensible sketch as their answers to (a) or (b) would not support one.

Question 5

Most candidates completed the table correctly, with few rounding errors seen. Common errors when plotting and drawing the graph included plotting $(3.5, 4.80)$ instead of $(3.5, 4.08)$ and plotting the point $(1, 0)$ but not drawing the graph through it. Most graphs were acceptable attempts at smooth curves but there were some cases where a ruler had clearly been used for part of the curve. In part (c), most realised that they needed to equate the line and the curve equations (eliminating y) but did not know what to do next or could not cope with the algebra needed. Part (d) was, surprisingly, omitted even by some who had been successful with (c). Errors here included not rounding the answers as instructed and only giving the larger of the two answers, even when their graph crossed the pre-drawn one in two places. Some tried to solve the equation instead of reading the answers from their graph; many could not solve it, others used a calculator to obtain values and often gave themselves away by either giving answers that clearly did not match their graph or including the third solution (-0.5).

Question 6

A few candidates appeared to not know what a geometric series is and either used the arithmetic series formulae or left this question out altogether. Some candidates used ar^n for the *n*th term but most were successful with part (a) even if they needed a lot of working to be able to solve the equations. Part (b) was a straightforward follow-on to (a) and it was rare to see candidates successful in (a) but failing in (b). In part (c), some candidates did not attempt to obtain the first term of the new series or multiplied 16 by r^2 instead of by r. Even those who found the new first term often forgot to use it in their summation formula, instead reverting to 16.

Question 7

There were many candidates who felt so unsure of their ability to tackle this question that they simply turned over to the next one; candidates should be encouraged to read, and think about, the whole question before doing this. There was an easy mark to be gained in part (b). Many candidates applied the product rule to differentiate $y = x^{\frac{5}{2}}a^{-\frac{3}{2}}$. A few did then realise that a was a constant and so found the correct gradient, albeit by a long route; others simply had an incorrect gradient. A surprisingly large number did not substitute $x = a$ and tried to find the equation of the normal with a gradient that was a function of x. Part (c) produced more problems. Candidates who knew to use the volume integral with the curve equation often used the wrong limits, probably as they knew the answer for (b) must be needed somewhere. Those who used the equation of the line often obtained the correct volume for the cone, which could have been obtained more quickly by using the formula for the volume of a cone. Very often the two volumes were subtracted instead of added.

Question 8

Part (a) showed how few candidates could complete the square successfully. The alternative method of expanding and equating coefficients provided its own problems as the resulting equations were rarely solved completely correctly. Many candidates differentiated the function to obtain the maximum but often stopped when they had found the necessary value of x. The last three parts of the question were more popular. However, with the quadratic being written in "reverse" order many gave the sum of the roots as $\frac{5}{3}$ and the product as $-\frac{7}{3}$. Even with correct algebra, accuracy marks cannot be awarded for correct answers based on incorrect sums and products. The equation in part (e) often had no equals sign or the final answer was given without integer coefficients. Some candidates did much more work than was needed to obtain the equation as they re-calculated the sum in spite of it already having been found in (d).

Question 9

Many good attempts were seen for parts (a) to (d) of this question. Most marks were lost in these parts due to inaccuracies resulting from using previously rounded answers in subsequent working. Some made $\angle VAD = 60°$ with disastrous results throughout the question. Part (e) challenged all but the very best candidates. Many equated the volume of the pyramid to the volume of the sphere; having drawn the sphere inside the pyramid could they not see the empty spaces? The specification for this paper assumes knowledge of the specification for 7361, which includes the circle theorems. An examination of the cross-section of the pyramid and the sphere through X, V and the foot of the perpendicular from V to the base and use of the equal tangents from a point to a circle enables this problem to be solved in a straightforward way.

Question 10

Candidates found this question difficult, apart from part (a) on which most gained the two marks allocated. Part (b) (i) was often attempted, usually in a valid manner. Those who managed to complete (b) (ii) often produced far more lines of working than was required to prove the result. Candidates had a greater success with part (c) although very few gave the full set of values, often as a result of dividing by $\cos\theta$ or $\cos^3\theta$ (depending on the method chosen) instead of factorising. Part (d) allowed some candidates to gain more marks although there are still too many who think that $\int \cos^5\theta \, d\theta = \frac{1}{6}\cos^6\theta$.

Statistics

Overall Subject Grade Boundaries

Grade	Max. Mark	A	B	C	D	E	U
Overall subject grade boundaries	100	75	59	44	39	32	0

Paper 1

Grade	Max. Mark	A	B	C	D	E	U
Paper 1 grade boundaries	100	78	61	44	38	33	0

Paper 2

Grade	Max. Mark	A	B	C	D	E	U
Paper 2 grade boundaries	100	71	57	43	37	31	0

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