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# Examiners' Report January 2009

GCE O Level

# AO Level Pure Mathematics (7362)

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January 2009

## Contents

# Pure Mathematics

# Specification 7362

# Paper 1

## Introduction

Candidates found paper 1 considerably harder than paper 2, probably because of Q2 and Q8 which are difficult topics. The responses, or lack of them, which were seen for Q2 suggested that many candidates are not taught this topic.

Some candidates have calculators which can solve quadratic equations simply by entering the coefficients in the correct manner. Whilst this is generally an acceptable way to solve an equation which is correct, it is inadvisable in an examination as there is no supporting working to be shown. If the answers are not correct (and an incorrect equation cannot yield correct answers) any method marks available cannot be awarded. In Q9 of paper 1 a follow through accuracy mark could not be gained either as all method marks must be earned before the final accuracy mark is given.

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.

## Report on Individual Questions

### Question 1

Many candidates adopted the harder route of using the cosine rule, needing two applications and the solution of a quadratic equation for the first. It is therefore unsurprising that there were few correct answers from this method. Candidates would be well advised to learn that the cosine rule is needed when all three sides or two sides and the included angle are given and all other situations are best dealt with by means of the sine rule.

### Question 2

Only the very best candidates could complete this successfully. Most did not appear to understand small increases and percentage increase. $\delta A = \frac{x}{100}$ was seen more frequently than $\delta A = \frac{x}{100} A$.

## Question 3

A large number of candidates equated the two equations, showing no understanding of the gradient of tangent. Of those who differentiated, many equated $\frac{dy}{dx}$ to 0 instead of 1. Some candidates found $a$ correctly but then used $y = x + 7$ to obtain $b$.

## Question 4

Most candidates know and can apply the product and quotient rules correctly. However, imaginary brackets earn few marks unless subsequent working (which was not necessary in this case) indicates clearly that brackets were intended.

## Question 5

There still seems to be some confusion about asymptotes, with some candidates giving answers in (a) which were not equations of lines. Some also think that the line $y = -1$ is parallel to the $y$-axis. Most scored 2 marks for (b) but lost marks in (c). Asymptotes were drawn without any indication of either their equation or where they crossed the axes and, when drawn correctly, some had graphs crossing them. The most common error was to omit the part of the graph in the third quadrant.

## Question 6

Part (a) was sometimes omitted and sometimes the total surface area was found. Even the later set of candidates usually went on to (b), using the expression on the paper. Part (b) was often completely correct though some thought that merely evaluating the volume for the two values of $x$ found was sufficient to establish a maximum. Only a small minority realised that $x$ could not be $\frac{100}{3}$ because of practical considerations of the situation under investigation. Some candidates picked pout an incorrect expression for the volume and so lost marks in (c).

## Question 7

There were some candidates who mis-interpreted the ratio in part (a) and so used $\frac{1}{5}$ instead of $\frac{1}{4}$. However, this did not reduce their opportunity to gain marks in (b) and (c) as the use of the ratio was considered irrelevant to the work being tested here. Most candidates could achieve some degree of success in (a) but then many left the rest of the question blank. In (b) several tried to equate vectors instead of using a multiple. In (c), those who obtained a correct expression for $\overrightarrow{EG}$ often used the **b** rather than the **a** component to obtain $\lambda$

## Question 8

Part (a) should have provided an easy 4 marks for most candidates but unfortunately some thought that they could use one result to prove the other and then reverse the process to prove the second. When a question demands that a stated formula be used it is essential that candidates show its use, in this case by writing $\cos 2\theta = \cos^2\theta - \sin^2\theta$, and not simply quote learned results such as $\cos 2\theta = 2\cos^2\theta - 1$. Part (b) was frequently attempted well, or omitted altogether. The most common mistakes arose when squaring eg $(\cos 2\theta)^2 = \cos 4\theta$. Of course, candidates making such mistakes miraculously managed to achieve the desired result! Candidates worked part (b) from left to right or right to left with the same degree of success. Part (c) was a straightforward application of the result in (b) but could also have been solved as a quadratic in $\sin^2\theta$. Most candidates gave their answers as exact multiples of $\pi$ though some used decimal multiples and others used degrees or radians. Whilst working in degrees which are then changed to radians is not penalised by marks (provided the answers are multiples of $\pi$), it does involve extra work and so incurs a time penalty, albeit a small one. In part (d), some students tried to integrate the given function as presented on the paper instead of using the result in (b) to obtain a function that could legitimately be integrated. The resulting integrand contained a $\theta$ which caught some candidates out as they were thinking in degrees and substituted 90 instead of $\frac{\pi}{2}$.

## Question 9

Those who constructed the initial equation correctly were usually able to obtain correct solutions for (a) and (b). Part (c) was less successful as some found the common ratio by using $r$ instead of $r^2$ and this resulted in an incorrect sum in (d). Errors were seen in (e) when obtaining the common difference of the arithmetic series. Most could set up the required inequality in (f) but there were many cases where it seemed that the critical values of the quadratic inequality had been obtained by use of a calculator which could solve quadratic equations. As this meant no method was shown it resulted in no further marks available for candidates whose inequality was incorrect due to a previous incorrect answer. Some candidates rounded their answer down instead of up.

## Question 10

Parts (a) and (c) were frequently correct. Those who made errors in (a) should have been alerted to this when they tried to factorise their expression in (b). Part (d) showed how few candidates could draw a cubic curve, even when they had the points where the curve crossed the $x$-axis. These points were to be marked on their diagram – this was intended to assist with drawing the curve. Many curves in (ii) stopped at the $x$-axis at one or both ends. Very few candidates recognised that the graph of $y = x^3 - 3$ was the same shape as the graph of $y = x^3$ but translated downwards. Many simply drew a straight line through the two intersection points found in (c). The purpose of the graphs was to assist with identifying the required area in (f). Only the best candidates reached a successful conclusion in (f). Some tried to split the area but rarely managed to arrange a split that covered the whole region and no more. Integrating both curve equations with the limits $-\frac{1}{2}$ and 3 (as obtained in (c) was the most efficient method.

# Pure Mathematics

# Specification 7362

# Paper 2

# Report on Individual Questions

## Question 1

Many candidates started by equating the line and the curve but not many candidates realised that a double root implied the line was a tangent to the curve and so did far more work overall than was needed. Acceptable concluding statements were few and far between.

## Question 2

Most candidates obtained a correct quadratic equation by use of the Pythagoras identity, however many could not solve $\cos\theta = \frac{1}{2}$ within the stated range. The second answer was often given as $300°$ (out of range) or omitted altogether.

## Question 3

The majority of candidates knew they needed to integrate the given expression but some did not realise that they also needed to obtain the values of $t$ when $v = 0$ as well.

## Question 4

Some candidates did not appreciate that they were required to sum an arithmetic series – they would have been well advised to write out a few terms of the series in order to examine their series thoroughly. In part (b), those who had a correct result in (a) were generally able to set up and solve the quadratic equation correctly but some did not gain the last mark as they failed to eliminate the inappropriate negative answer.

## Question 5

Some of the lines were not drawn sufficiently long to fully enclose the region to be shaded. Unsurprisingly, particularly in these cases, the incorrect region was often shown.

## Question 6

In part (a) the majority eliminated $y$, solved their equation for $x$ and then substituted back to obtain $y$. As long as they then gave the value of $x$ in part (b) this gave access to all three marks for the two parts. Common errors in (c) were to subtract the two equations before squaring or to fail to square $\frac{1}{8}x^2$. Some candidates only found the volume of revolution for one of the curves. It was unusual to see $\pi$ omitted.

## Question 7

There were many fully correct responses to this question. Most of the errors seen occurred in (b), particularly when adding the fractions where the algebra required defeated some. Most candidates knew how to form the required equation, using their sum and product of the roots but some forgot to include = 0.

## Question 8

Part (a) was a straightforward introduction to a question on logarithmic equations. Part (b) required a change of base for one of the two logarithms; many managed that but then did not realise that they needed to proceed to a quadratic equation. Those who obtained a correct quadratic found it factorised easily and they obtained the solutions and proceeded to "undo" the logarithms. Some unfortunately gave $m = 2.8...$ as the solution to $m^{\frac{1}{2}} = 8$. Most candidates realised, in (c), that they needed to solve the two equations simultaneously. Some changed the logs to $x$ and $y$ in order to do this – and in a few cases this meant that they forgot to convert back to the logarithms and solve to obtain the true $x$ and $y$.

## Question 9

In parts (a) and (c) candidates did not always round their answers as instructed – some being given correct to 3 decimal places and others to only one. In parts (b) and (d) the plotting of points was not always correct, leading to strange bumpy curves. Candidates at this level should be aware that a cubic curve has, at most, a single maximum and a single minimum point and is smooth, so they should have been alerted to their errors by the strange curve they were drawing. Many candidates gave no working to justify their answers for part (e); of those who did, many eliminated $y$ between the two curve equations and re-arranged to obtain the equation they were required to solve. This is a fully acceptable approach. Very few realised that they needed 2.0 for that answer, as it could not be exact and 1 decimal place had been demanded. The other answer was frequently given to 2 decimal places. Many candidates had difficulty re-arranging the equation given in (f) to obtain the equation of the line to be drawn. Often the $x$-coordinate of the points of intersection with both curves were given or the $y$-coordinate stated as well.

## Question 10

The binomial expansion was usually known but errors were made in manipulating the negative signs and when simplifying the $x^2$ term. In part (b) candidates could substitute $x = \frac{1}{27}$ in their expansion, as instructed but few could make the connection to $\sqrt[3]{21}$, often stating that $\sqrt[3]{21} = 0.920438$. Did they not notice that this was so far from the accurate value that it was unlikely to be correct? Part (c) also produced incorrect work. Some candidates were not familiar with the percentage error formula, others took an approximation from their calculator and used that to calculate the percentage error. As a calculator is needed to perform the calculation it is far better, both in terms of not introducing further error and in efficiency, to enter $\sqrt[3]{21}$ directly onto the calculator. In part (d), most candidates either attempted to expand $(1+x)^{-3}$ and multiply the result by $(1-2x-4x^2)$ or, less commonly, attempted to expand $(1+x)^3$ and multiply the result by $(a+bx+cx^2)$, and then equated coefficients. Responses to (e) indicated that candidates rarely seem to be aware of the condition for convergence of an infinite binomial expansion.

## Question 11

Most of the candidates who had sufficient time left were able to make a good attempt at this question. Unfortunately many lost accuracy by rounding $\sqrt{116}$ to 10.8 and this affected the final answers to parts (a), (b) and (d). Candidates should be aware that if final answers are to be correct to 3 significant figures (or 1 decimal place for the angles) then more than 3 figures must be used in all intermediate working. It is surely as easy to enter $\sqrt{116}$ on the calculator as to enter 10.8, so it would have been better to keep to the exact value until the final answers are reached. Most, if not all, of the work in a question like this is based on right-angles triangles. Part (e) was no exception, but many candidates failed to spot the right angle at $F$ and so used the cosine rule instead which made this part of the question considerably more lengthy than was intended.

# Statistics

## Overall Subject Grade Boundaries

| Grade | Max. Mark | A | B | C | D | E | U |
|---|---|---|---|---|---|---|---|
| Overall subject grade boundaries | 100 | 74 | 56 | 39 | 35 | 30 | 0 |

## Paper 1

| Grade | Max. Mark | A | B | C | D | E | U |
|---|---|---|---|---|---|---|---|
| Paper 1 grade boundaries | 100 | 68 | 53 | 35 | 30 | 26 | 0 |

## Paper 2

| Grade | Max. Mark | A | B | C | D | E | U |
|---|---|---|---|---|---|---|---|
| Paper 2 grade boundaries | 100 | 80 | 62 | 44 | 39 | 34 | 0 |

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