Examiners' Report Summer 2008

GCE

GCE AO Level Pure Mathematics (7362)

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Introduction

Although the intention is that both papers are of the same standard candidates usually find one paper is slightly harder than the other. Of this pair, paper 1 was very slightly harder as shown by a difference of 1.5% in the mean marks for the two papers. As candidates had a few days longer to revise for paper 2 this would clearly suggest that paper 2 was more difficult.

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. Use of the calculator to obtain intermediate decimal answers when exact final answers are required should be avoided. However, there is evidence that some candidates seem reluctant to use the fraction button on their calculator; fractions are exact whether evaluated with or without the aid of a calculator. 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. Finding answers in degrees when radians are demanded and then changing those answers to radians only makes the solution more involved and wastes time. This practice might be excusable for the first part of a question but once it has been realised that radians are needed it would be far more efficient to change the mode of the calculator.

Sketch graphs are now almost always done in the examination booklet instead of on graph paper as frequently occurred in the past. Candidates on the whole seemed to be better advised about using extra sheets if the space provided was not sufficient for a particular question and not using blank pages or surplus space intended for a different question but there were still some who completed answers in another part of the booklet, not always 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.

Paper 1

Report on Individual Questions

Question 1

Many candidates produced short, fully correct solutions for this question. Some however seemed to be unaware that the largest angle is opposite the longest side and although the work they did was correct and gained them full marks they had wasted valuable time. A few even used the cosine rule three times; had they forgotten the angle sum of a triangle?

Question 2

This was another question which was answered correctly by the majority of candidates. However a few equated the quadratic to zero instead of eliminating y between the two equations.

Question 3

In contrast to the previous two questions the majority had little idea how to tackle this typical connected rates of change question. Many assumed h = 10 from the start of their work, others tried to differentiate $V = \frac{1}{3}\pi r^2 h$ with respect to r by assuming h to be a constant. Most candidates knew the chain rule was needed and quoted it in a suitable form but were unable to apply it to the question. Even the candidates who could do the work usually forgot that differentials showed rates of *increase*; this question was about a *decreasing* volume and so some minus signs were needed to reflect this.

Question 4

Most candidates could tackle the differentiation in both parts of this question correctly although there was some confusion about the signs in the product and quotient rules. The common errors were to differentiate $x - x^2$ incorrectly to obtain $-2x$ and to make sign errors when simplifying in (b).

Question 5

(a) was frequently answered correctly but some candidates misinterpreted the ratio information and used $\frac{2}{3}\overrightarrow{AB}$ instead of $\frac{2}{5}\overrightarrow{AB}$. However, many candidates appeared not to know what a unit vector is. A large number simply found the modulus of $\overrightarrow{AB}$ but did not know what to do with it. Part (c) was more testing. The better candidates were successful. However, quite a few candidates made a start by finding $\overrightarrow{DA}$ or another useful vector but then were unable to use the parallel or collinear property of two vectors in order to complete their solution.

Question 6

Parts (a) and (b) made a good start to this question and most candidates were able to show that they had some knowledge of log theory. In part (c), candidates who could almost certainly have factorised a basic algebraic function seemed thrown by the presence of logs in their expression. Some candidates tried to remove this obstacle by substituting a letter for $\log_x 3$; unfortunately they often chose x. Part (d) was usually solved well by those who had managed (c) although some undid the log correctly obtaining $x^{\frac{1}{2}} = 3$ but then gave their answer as $x = \sqrt{3}$. The answer $x = 5$ was missed by some; this answer could also have been given by those who had been unsuccessful with (c) but was rarely seen in this situation.

Question 7

Most candidates were successful with parts (a) and (b). In part (c) most showed that they knew the method required and obtained $x^3 = \frac{700}{40}$. However many either had not read the question properly or did not fully understand it as they failed to use their value of x to obtain the minimum value of A. Most knew what was required in (d) but some made mistakes in obtaining the second differential, 700 instead of 1400 being the most common. Some failed to give a full demonstration. Candidates must be careful to show the examiners that they know why they have established a minimum (as the question states that they have one). Stating that $\frac{\mathrm{d}^2 A}{\mathrm{d}x^2} > 0$ implies a minimum is therefore essential.

Question 8

Almost all knew what to do in part (a) and many obtained a correct equation and proceeded to find the correct values for x. The most common error was careless collection of terms in the equation. Again, in (b) most could find the correct values of r corresponding to their values of x. In (c), a convergent series was needed so $|r| < 1$. Some candidates were now confused between their x and their r; others failed to obtain a correct value for a – a =11 was seen frequently. Part (d) was found to be very difficult by many candidates. Numerical values of n were used and many did not understand percentage error. A few candidates started to use the formula for the sum of an arithmetic series while others attempted to equate their S_n and their S. A few very elegant solutions were seen where candidates worked with the formulae for S_n and S, only substituting for r in their final answer.

Question 9

Some candidates knew the formula required in part (a), so just wrote it down. This was not sufficient as the question clearly stated "using the identities…". Some candidates did not realise that they needed to use $\sin^2\theta + \cos^2\theta = 1$ to obtain the answer, although they used it quite happily in (c) to remove $\sin^2 A$. For (b), there was no working to be shown (only 1 mark allocated) so writing down a known formula was adequate. Most candidates either worked accurately through (c) or gave up; there was less evidence of fudging a printed result than is often seen. In part (d), many knew to make use of the result from (c) to obtain a solvable equation. Some seemed to think that the cubed must be a misprint and changed it to squared, others simply tried to use the quadratic formula to solve the cubic equation with no such change. As always, not all candidates produced the three answers in the stated range. When integrating in part (d) some realised that they needed to change the integrand but used the equation in (d) rather than the identity in (c), others tried to integrate $\cos^3\theta$ to $\sin^3\theta$. There were many fully correct solutions, either by using the result in (c) or, more rarely, by changing $\cos^3\theta$ to $\left(1-\sin^2\theta\right)\cos\theta$.

Question 10

Many correct solutions were seen for (a) but a substantial minority used $\mathrm{f}\left(2\right) = 0$. These candidates could follow through for method in (b) provided that was their only error but most who made other careless errors in (a) had equations which they could not solve. In part (c) some found the gradient of the line *AB* or *BD* instead of differentiating the equation of the curve. In spite of having a correctly drawn curve on the question paper, many were unable to correctly identify the area required in (d) or to divide it into two parts accurately. Some unnecessarily divided it into an area under a curve, a trapezium and a triangle giving themselves extra work, some solved the equations of the line and the curve in order to obtain the limits for their integrals while others used 1 and 3 as their limits. The line minus curve method was seen quite frequently although it was not appropriate for the required area.

Paper 2

Report on Individual Questions

Question 1

Most candidates realised that they needed to work with $b^2 - 4ac$ in this question but some used an incorrect inequality. Squaring 2*p* posed problems as did removing the bracket round $10 - 3p$. Most errors appeared at the final stage. Many candidates who had correct critical values then tried to combine them into one inequality, either by choosing the middle region for their final answer or stating $-5 > p > 2$.

Question 2

Many candidates had little idea how to approach this question and either left the page blank or wrote very little. There were many attempts to sum a single (incorrect) series though a few did realise that by adding $6+7+8+9$ followed by $11+12+13+14$ etc they could form a single correct series with the required sum. Of those who realised that they could obtain the correct answer by finding the difference between two separate series many thought there were 190 terms in the sum of the integers from 5 to 195. Most did manage to get one of the summations correct. A few candidates adopted the laborious but safe method of writing down all the numbers required; most of these arrived at the correct answer.

Question 3

There were many fully correct attempts at this question but a significant proportion of candidates failed to find the midpoint of the line and simply found the equation of the perpendicular through one of the given points. Some candidates seemed unaware of the formula for the gradient of the line through two points, instead obtaining the gradient by first finding the equation of the line.

Question 4

The formula for a volume of revolution was known by most although some omitted the π. Many made errors squaring the bracket and incorrect limits (0 and 3) were seen frequently, even by those who had correctly identified the points where the curve crossed the *x*-axis. Not all answers were given to three significant figures and some left their answer as a multiple of π.

Question 5

Only a very small minority failed to gain both marks for (a). There were a few who thought integration was required and a few who tried to use constant acceleration methods. There were many completely correct solutions to (b) though some evaluated their integral for all integer values of *t* from 0 to 6 and added their results. Some candidates took the long route of finding the distance travelled in each second and adding these distances; this did give them the correct answer but it at a significant cost in time!

Question 6

A few candidates got the asymptotes the wrong way round in part (a) (ie $x = -1$ for (i) and $y = 3$ for (ii)). There are still some candidates who think a page of working is required to obtain an equation for an asymptote when it should be possible to simply write it down. Finding the coordinates of the points where the curve crossed the axes was less of a problem. Many sketches had only one branch of the curve, a few curves crossed an asymptote and the points where the curve crossed the axes were not always labelled. A few curves also crossed the axes at more points than had been established in (b). Sketches were done in the answer space (as required) but not always in the unlined section provided for the purpose.

Question 7

This question allowed many candidates to demonstrate their algebraic skills to the full. A few made sign errors when deducing values for $\alpha + \beta$ and $\alpha\beta$ from the given equation; a more common error was to evaluate $(\alpha + \beta)^2 - 2\alpha\beta$ as $k + 10$. Part (b) should have alerted them to their error as this mistake led to only one value for *k* instead of the *values* requested. Some candidates could not evaluate $\frac{1}{\alpha^2} + \frac{1}{\beta^2}$ correctly in (c) but most were able to form a correct equation with the given roots. The final mark was frequently lost however through failing to change the equation to one with integer coefficients or omitting the "= 0".

Question 8

Many candidates worked with degrees in this question, including some who knew radians were required and so converted their answers to radians. Learning to use the calculator in radian mode would be advantageous even to the latter group; they did not incur the penalty for degree answers but often rounded numbers too early in the process resulting in incorrect final answers. Answers given in radians as a multiple of π could never count as being rounded to 3 significant figures and so also incurred a penalty. In part (a), some candidates multiplied out the brackets, only to then re-factorise, often incorrectly. In part (b) some candidates treated the tan function as a multiplier and wrote $\tan\left(2\theta - \frac{1}{3}\pi\right) = \tan 2\theta - \tan\frac{1}{3}\pi$, thereby scoring zero for this part of the question. In part (c) most realised that they needed an equation in $\cos\theta$ and used $\sin^2\theta + \cos^2\theta = 1$ correctly to achieve this. Errors in solving the resulting quadratic lost some candidates the final A marks.

Question 9

The combination of an arithmetic series with logarithms caused many candidates to forget their log theory. In part (a) many candidates were able to set up the initial equations correctly and then they attempted to eliminate *a* between them. However, $\log pq^4$ and $\log pq^8$ frequently became $4\log pq$ and $8\log pq$. In part (c) most candidates used a correct formula with their values for *a* and *d* but only a minority could manipulate their expression to a single logarithm with even fewer having a fully correct expression. Some candidates who had a compact expression for the final stage in (c) realised that using this made an efficient method of approaching (d). Most returned to the basic summation formula. Both groups could set up a correct equation from the given information (allowing for incorrect values for *a* and *d*). Far more then claimed to have deduced the required result than produced accurate work to justify it! There was an apparent reluctance to keep the numbers in (d) small by cancelling the common factor of 8 from 16 and 10×4.

Question 10

There is a general competence in the application of the binomial expansion with most candidates scoring at least 5 of the 6 marks available in parts (a) and (b). Some lost marks through failing to simplify their terms fully and others lost them, particularly in (b), through problems with fractions and signs. Few candidates however seem aware that there is a condition which must be met for an expansion with a fractional index to be valid and so failed to gain the mark in (c). In part (d) most realised that they needed to multiply their expansions from (a) and (b) together even if they had failed to cancel the 2s correctly and so had double (or some other multiple of 2 times) the final result. The majority who attempted (e) realised that they needed to integrate their expansion from (d) although in some cases this led to strange attempts to integrate complicated quotients.

Question 11

Some candidates made little or no attempt to answer this question. It was impossible to know whether it was lack of time or lack of inclination. Solutions to (a) and (b) were often combined with candidates finding the length of *VA* first and then using that to obtain the height. As long as their method was valid from the given information they could score full marks for both parts. Unfortunately some used the given height of the pyramid to obtain the length of *VA* and then the length of *VA* to obtain the height. This could never be acceptable. Others showed that $AC = 12\sqrt{2}$ and then stated that $\frac{1}{2}AC = 6\sqrt{2}$ and so the height was also $6\sqrt{2}$ without any evidence for their final step. This is of course correct for this particular pyramid as $\angle VAC = 45°$, but this (or a similar) fact must be provided as evidence. The greatest loss of marks in parts (a, (b), and (c) was due to resorting to decimals for the working and then claiming that the decimal answer was the same as the accurate answer required. Once accuracy is lost by using decimals it is gone for ever. In part (c) some candidates obtained $\sqrt{108}$ for their length of the perpendicular but were then unable to change this to the required form with the square root of a prime number. Exact answers were not demanded in (d) and (e) so decimals for all measurements were allowable in the working. The required angle in (d) was readily identified and then calculated correctly. However, only the best candidates could identify the angle required in (e). Once identified however most realised that part (c) was intended to assist in the calculation.

Statistics

Overall Subject Grade Boundaries

Grade	Max. Mark	A	B	C	D	E	U
Overall subject grade boundaries	100	79	63	47	42	33	0

Paper 1

Grade	Max. Mark	A	B	C	D	E	U
Paper 1 grade boundaries	100	80	64	49	41	34	0

Paper 2

Grade	Max. Mark	A	B	C	D	E	U
Paper 2 grade boundaries	100	77	61	45	37	31	0

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