

GCE 2004

June Series



Report on the Examination

Use of Mathematics

5351

-
- UoM4/1 Applying Mathematics Paper 1
 - UoM4/2 Applying Mathematics Paper 2
 - 6990 Using and Applying Statistics
 - 6991 Working with Algebraic and Graphical Techniques
 - 6992 Modelling with Calculus

Further copies of this Report on the Examination are available from:

Publications Department, Aldon House, 39, Heald Grove, Rusholme, Manchester, M14 4NA
Tel: 0161 953 1170

or

download from the AQA website: www.aqa.org.uk

Copyright © 2004 AQA and its licensors

COPYRIGHT

AQA retains the copyright on all its publications. However, registered centres for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to centres to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales 3644723 and a registered Charity number 1073334. Registered address AQA, Devas Street, Manchester. M15 6EX. *Dr Michael Cresswell Director General*

CONTENTS

5351

	<i>Page No.</i>
UoM4/1 Applying Mathematics Paper 1	5
UoM4/2 Applying Mathematics Paper 2	7
6990 Using and Applying Statistics	9
6991 Working with Algebraic and Graphical Techniques.....	11
6992 Modelling with Calculus.....	13

	<i>Page No.</i>
Coursework Portfolios 6990, 6991, 6992	15

Mark Ranges and Award of Grades.....	16
--------------------------------------	----

Applying Mathematics

Paper 1 (UOM4/1)

General

Many candidates were well prepared for this paper and appear to have worked well with the pre-release material to ensure that they were familiar with the context of the article. There was evidence that candidates had been able to spend time working in the examination to gain the marks available for presenting their responses:

- accurately using correct notation, and
- clearly and logically.

Those candidates who gained the highest marks in these categories ensured that care was given to the use of correct notation throughout their work, wrote their responses using clear statements and included linking notation and symbols as well as words.

Question 1

Most candidates gained full marks for the first part of this question: a common error amongst the minority who did not get the correct answer was to confuse 365 days with 360 degrees. Fewer candidates gained the mark for the second part of the question with a significant number referring directly to the statement in the text that the Earth makes a complete revolution in approximately 24 hours rather than suggesting that the Earth's rate of rotation needs to be constant.

Question 2

Most candidates were able to read the appropriate value from the graph in figure 3 to allow them to find the time that the sundial would be indicating at noon on 30th March, but a number went on to misinterpret the article and gave the incorrect time. In part (b) of the question, the majority of candidates were able to work successfully with the expression for the correction, E , and were able to confirm that they had found the correct value from the graph in their answer to part (a).

Question 3

The majority of candidates successfully answered this question, with a substantial number drawing on the information given in question 2 that on March 30th $N = 90$.

Question 4

This question was not well answered by most candidates. To gain full marks for such questions, it is important that candidates give all necessary information about the geometric transformations and use correct mathematical terminology.

Question 5

Most candidates gained the mark for part (a) of this question and went on to produce a graph that was an approximate sketch. However, it is important to ensure that the significant features of the graph are given. In this case, therefore, it was important to ensure that the sketch appeared to have the correct wavelength. The interpretation of the graph that was required, in terms of daylight at the North Pole over the course of a year, was not always well done, although a substantial number of candidates were able to gain some credit by indicating an awareness that there were periods of complete darkness.

Question 6

The majority of candidates answered both parts of this question correctly, appearing to be able to link together all of the information given in the article to make sense of the analemma.

Applying Mathematics

Paper 2 (UOM4/2)

General

Most candidates were able to successfully engage with a substantial amount of this paper and many of their responses that required interpretation of a situation that was being modelled showed that they often had a good understanding of this. There was evidence that candidates were able to re-engage with later parts of questions even if they had lost their way in an earlier part. A substantial number of candidates lost marks when giving graphical answers due to carelessness.

Question 1

The majority of this question was answered well by the majority of candidates. Many candidates gained full marks for their answers to parts (a) and (b), although some drew graphs for people with negative mass and height. It is important that candidates always consider the real situation being referred to when considering their responses. Part (c) was less well answered, although a substantial number of candidates gave correct responses; again some candidates' answers suggested that people could have negative heights. The final part of the question was not well answered, with many candidates unable to demonstrate an understanding of how to cope with a change of units from metres to centimetres.

Question 2

The majority of this question was well done by many candidates, although a small minority confused the experimental and accident data. Others worked incorrectly and calculated extreme values for the motorist's speed with which they did not seem surprised. Part (d) was answered correctly by many of those who had been successful with preceding parts of the question and their answers showed some careful and thoughtful reasoning. Some tackled this final part by experimenting with different values which, whilst time consuming, often proved a successful strategy.

Question 3

Many candidates were able to tackle most parts of this question successfully, although not all candidates were always able to relate numerical values to the real situation of the cooling tea. In part (a), some candidates suggested that the temperature of the tea when first made was 78°C , omitting to add the 18°C . In part (b), a common strategy was to substitute a relatively large value for t into the expression, although in most instances the value chosen was not large enough to give a suitable answer.

In sketching a graph of the function in part (c), some candidates did not mark details of significant features such as the intercept with the vertical axis and the horizontal asymptote.

Part (d) of the question, which required candidates to describe geometrical transformations of the function $T = e^{-0.02t}$ to give the graph of $T = 78e^{-0.02t} + 18$, was generally not well answered. Those candidates who did have some understanding of the underlying ideas did not always express their answer using correct mathematical terminology and some gave the transformations in the wrong order.

Those candidates who had correctly answered parts (a) and (b) were often able to correctly identify the meaning of the parameters A and B in part (e), although a substantial number suggested that B was the initial temperature of the cup of tea rather than the amount by which its initial temperature exceeded that of the surroundings.

Question 4

This question was answered well by many candidates who seemed well prepared for such a question. The only part of the question that proved slightly difficult for some candidates was filling in the table in part (e), where, after correctly identifying the type of bar, they applied the wrong rule to find the type of token. In part (e), most candidates were able to correctly identify a way of customers having to buy fewer bars to collect sufficient tokens to claim a medal.

Question 5

This question was the least well answered on the paper. Part (a) was answered correctly by those candidates who worked with the recurrence relations methodically. The algebraic nature of parts (b) (i) and (ii) proved problematic for many. However, many of those candidates who had difficulties working with the expressions in earlier parts of the question were able to work with the recurrence relation given in (b) part (ii) to successfully complete the table required in (b) part (iii). The interpretation required in (b) part (iv) was tackled successfully by many.

Using and Applying Statistics (6990/2)

Advanced

Paper 6990/2

General

This paper appears to have been accessible to the vast majority of candidates who seem to have been well prepared to tackle the required calculations and to interpret their results in terms of the situations that the data described. Again this year, most candidates tackled the questions in the order presented on the paper; there is no requirement to do this and candidates may find it advantageous to work through questions in a different order so that they feel more comfortable.

Question 1

This proved to be a straightforward first question with many candidates correctly calculating the statistical measures and commenting on these.

Question 2

This proved straightforward for the vast majority who calculated the measures (mean and standard deviation) using the statistical facilities on their calculators. Those candidates who attempted to calculate the standard deviation long-hand were often unsuccessful. Most candidates gave clear interpretations of what the measures meant in terms of the heights of the children at the different ages.

Question 3

Those candidates who were well prepared to tackle the calculations required in a normal distribution question of this type found the calculation required in part (a) straightforward and gained full marks. There was a substantial number of candidates, however, who appeared to have no idea where to start with this part of the question. Those candidates who were able to arrive at an answer for part (a) were usually successful with part (b); the vast majority were aware of the context and rounded their answer to a whole number (of children). Fewer were successful with the final part of the question, failing to comment on the idea of the normal distribution being a theoretical model of reality.

Question 4

Responses to this question were invariably disappointing with a number of candidates referring to a random sample rather than a representative sample. Only a minority of candidates suggested that a representative sample should contain adults and children and represent different factors such as sex and age in proportion to their occurrence in the whole population.

Question 5

Part (a) of this question was successfully answered by many candidates. The remaining parts of the question were not tackled so successfully. In answering part (b), some candidates focused on the split of journeys into those of a mile or more and those less than a mile rather than the number of journeys compared with their distance. Many candidates appeared to have little idea about how to tackle the final part of the question.

Question 6

Almost all candidates were able to find the mean wingspan from the given graph, but few mentioned that the line of best fit passes through the mean value for both variables. Many candidates gained the majority of marks available in part (b). Those candidates who attempted to work with the raw data in part (c) were unsuccessful, as they were not able to identify which data pair was repeated; however, many candidates were able to work with the appropriate method.

Question 7

The majority of candidates were able to use the given cumulative frequency graph to find the statistical measures required but a sizeable minority attempted to find values at cumulative frequencies of 75, 150 and 225, having divided the maximum value on the vertical scale into four parts. Only the better candidates were able to give a clear reason why the interquartile range might remain the same after two years.

Question 8

Many candidates gained a substantial number of marks on this final question of the paper. A common incorrect method of working was to take the age range in the final group as 14 years although the question drew attention to the fact that it was in fact 15 years. In part (b), some candidates made no attempt to cancel down their ratio to its simplest form. Almost all candidates were able to give the correct interpretation required in part (c).

Working with Algebraic and Graphical Techniques (6991/2)

Advanced

Paper 6991/2

General

This paper was accessible to candidates with many showing that they were well prepared. The standard of presentation was usually good, but too many candidates tried to compress their answers onto one or two sides of paper and this made it more difficult to mark. The graphical questions were well answered in comparison with the algebraic questions but too many candidates just plotted the points in questions 2 and 6 and then failed to join up the points. Too many used Trial and Improvement to solve equations and so gambled on gaining all or no marks. The descriptions of geometrical transformations were very poor.

Question 1

In part (a), many candidates truncated the value of $1/150$ to 0.006 but often this was their only error in the question. Weaker candidates did part (a) and (b) well but could go no further. Some said that b was the gradient and a was the intercept in part (c). Most candidates did part (d) correctly, but most failed to rearrange the equation in part (e) with common errors being 54 from $503 / 9.25$ or 41 from $500 / 12.25$ or 6.25×500 or failing to give the answer as a positive integer.

Question 2

Most candidates had no problems with parts (a) (b) or (c), but weaker candidates could go no further. More got the value of p than q in part (d), with 4 being a common answer for q . In part (e), some gave p as the height and q as the time and some said it gave the coordinates of the maximum point without specifying which was the height and which was the time.

Question 3

Very few used the word “translation” in part (a)(i), saying “shift” which was not accepted. Most got part (a)(ii) correct, with 21 being the usual error. It was rare for candidates to score full marks in part (b), but usually a curve with the correct curvature was obtained. Most drew curves starting near (0,12) and finishing near (12,0). Some drew the inverse function of the graph on the axes in question 2.

Question 4

Many scored very well on all parts of this question. In part (a)(i), the usual error was to multiply the value at one year by 5, to give £25 761. In part(a)(ii), the common error was to see $2000 = e^{0.03t}$. Similar errors were seen in part (b), with 25 750 in part(b)(i) and $2000 = 1.03^t$ in part (b)(ii), and other errors were $1.4 / 1.03$ or $1.4 / \sqrt{1.03}$. Part (b)(ii) was the hardest part of this question. Most got part (c) correct, with practically all starting at 5000 and only a few having curve Q below curve P .

Question 5

Most candidates got part (a)(i) correct but many did not draw a tangent in part (ii) and gave 17 / 20. Many got 7.9 in part (b)(i) but it was very rare to see 52.1, with errors such as $8 / \sin 3$ or $8 / \sin 20$ or $12 = \sin(3x)$ being common. Many did not attempt part (b)(ii). Many candidates could not calculate the y value in part (iii), with $\sin 20 \times 3 \times 55 = 56.4$ and $(20 \sin 3) \times 55 = 57$ being common errors, and then some divided by 5.18 instead of 6. In part (iv), many wrote about the amplitude and the period or said that the x values were “squashed”.

Question 6

In part (a), many candidates calculated the correct values for y but were unable to plot them to the required $\frac{1}{2}$ -square accuracy. Many gave an answer of 10 for part (b) and did not attempt part (c), but part (d) was usually done well with the usual error being 14.9 from reading off from their graph.

Modelling with Calculus (6992)

Advanced

Paper 6992/2

General

The majority of candidates were well prepared for this examination. Questions one and two were found to be a good source of marks and many candidates were able to show their skills. However, the solution of a quadratic equation, in question 1 part (b) (ii) and question 2, caused problems to a significant number of candidates. Question 4 was answered well by many candidates who showed their knowledge of the principles of trigonometric curves.

Question 1

Part (a) was answered well, although a minority thought that the answer of $9[\text{ms}^{-1}]$ in part (a) (ii) referred to the plane's initial height, which they gave to be 9 metres.

Part (b) (i) was usually answered correctly.

Most obtained $80 = 9 + 5.4t - 0.09t^2$ in part (b) (ii), but few could calculate its solution.

In part (c), most candidates found the correct velocities after 12 and 18 seconds, but to find the acceleration after 15 seconds they divided by two rather than six, the time interval.

Part (d) was usually completed correctly. Except for the minority who did not integrate the terms, parts (e) and (f) were answered well.

Question 2

Most candidates attempted to differentiate the given cubic in order to find the maximum of C . The majority obtained $3t^2 - 12t + 9$ which they equated to zero. A significant proportion then made no real progress in solving this quadratic, whilst a few obtained $t = -1$ and -3 . Those who did obtain $t = 1$ and 3 as the solution quickly found the maximum of C to be 8.

Part (b) was answered well. In part (c) (i), most candidates attempted to use the trapezium rule but they often simplified it by using a different number of strips or by using only integer approximations to the values of C . In part (c) (ii), those who integrated each term correctly quickly obtained the correct value, although often $\int 8 dt$ was given as 8. Parts (c) (iii) and (d) were well answered by most

candidates. Most candidates could show that $\frac{d^2C}{dt^2} = 0$, but could rarely state the relevance of this result.

Question 3

Many candidates answered part (a) well. However a significant proportion who obtained

$$300 = 400 e^{-\frac{1}{5}t} \text{ then set } -\frac{1}{5}t \text{ equal to } \frac{\log 300}{\log 400} \text{ rather than } \log \frac{300}{400}.$$

In part (b), many did not obtain the correct value for $\frac{dX}{dt}$ and, in part (c), few simply substituted the

value found in part (a) into $-80 e^{-\frac{1}{5}t}$ to obtain the required value, -60 . Many attempted to find $\frac{dX}{dt}$

using $-80 e^{-\frac{1}{5}t}$ but gave up when they realised they only knew x but not t .

Question 4

In part (a), most found the value of h required. Encouragingly this session, only a few did not appreciate that they should use radians.

Part (b) (i) was answered quite well and part (ii) was often answered by considering the shape of the trigonometric curves. Those who used a decimal equivalent in part (ii) for $\frac{\pi}{8}$ rarely obtained the required accuracy in part (iii), with 1.95 being a common answer. Only one candidate gave the correct answer in part (c) with many giving any of the numbers mentioned in the question, often 2!

Coursework Portfolios

Advanced

General

It was noticeable that this year there was again a considerable increase in the entry for the advanced courses. The candidate entry was usually good and there were many instances of cross-curricular work being done competently.

The portfolios moderated this year included many which were of a very high standard. Quite a number were clearly written principally for their other studies and this cross-curricular work stimulated candidates to produce interesting portfolios of the highest standard. In the unit entitled "Working with Algebraic and Graphical Techniques", many showed good quality work using exponential and logarithmic functions. These regularly achieved forty or more marks. In the advanced statistics unit, two investigations are required. These must be two investigations with two different sets of data, not two different investigations, such as Chi square and Mann Whitney U-test, on the same data.

The majority of portfolios moderated were assessed correctly. The amount of annotation given varied widely between centres but in general the candidate record sheet contained enough information for the moderator to be able to confirm the centre's work.

A few centres gave their students tasks which were too structured and this prevented some candidates from being able to show their individual skills and initiative.

It was noticeable that candidates were attempting to show more explicit checking as was required in Theme 2, Using Appropriate Mathematics and Working Accurately. However candidates still find difficulty in showing clearly where checking has taken place

Administration

With the huge increase in the entry for AS Use of Mathematics, one problem was seen regularly. One centre declaration sheet confirming that the centre has carried out internal moderation is required for each level. All centres which entered their candidates for AS Use of Mathematics naturally entered their candidates for at least two advanced FSMQ units. Most of these centres supplied two or three centre declaration sheets, one for each unit. However, only one sheet was required, confirming that each unit at Advanced level had been assessed at the same standard.

Mark Ranges and Award of Grades

UOM4 Applying Mathematics (557 candidates)

Unit/Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
UOM4/1: Coursework Portfolio	30	30	14.8	5.3
UOM4/2: Written Paper	70	70	27.3	12.2
UOM4: Applying Mathematics	100	100	42.1	16.0

		Max. mark	A	B	C	D	E
Boundary Mark	raw	30	22	20	18	16	14
	scaled	30	22	20	18	16	14
Written Paper Boundary Mark	raw	70	50	44	38	33	28
	scaled	70	50	44	38	33	28
Unit Scaled Boundary Mark		100	72	64	56	49	42

6990 Using & Applying Statistics (526 candidates)

Unit/Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
6990/1: Coursework Portfolio	51	51	25.2	11.0
6990/2: Written Paper	60	51	23.0	9.6
6990: Using & Applying Statistics	111	102	48.2	17.2

		Max. mark	A	B	C	D	E
Coursework Portfolio Boundary Mark	raw	51	40	32	24	17	10
	scaled	51	40	32	24	17	10
Written Paper Boundary Mark	raw	60	47	41	35	30	25
	scaled	51	43	37	32	28	24
Unit Scaled Boundary Mark		102	80	67	55	43	31

Provisional statistics for the award

	A	B	C	D	E
Cumulative %	4.0	16.3	35.2	57.0	81.0

6991 Working with Algebraic & Graphical Techniques (792 candidates)

Unit/Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
6991/1: Coursework Portfolio	51	51	27.6	10.4
6991/2: Written Paper	60	51	19.5	8.5
6991: Working with Algebraic & Graphical Techniques	111	102	55.6	15.7

		Max. mark	A	B	C	D	E
Coursework Portfolio Boundary Mark	raw	51	40	32	24	17	10
	scaled	51	40	32	24	17	10
Written Paper Boundary Mark	raw	60	43	39	35	31	27
	scaled	51	37	33	30	26	23
Unit Scaled Boundary Mark		102	77	66	55	44	33

Provisional statistics for the award

	A	B	C	D	E
Cumulative %	8.8	27.4	54.3	75.0	89.9

6992 Modelling with Calculus (141 candidates)

Unit/Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
6992/1: Coursework Portfolio	51	51	30.2	11.8
6992/2: Written Paper	60	51	25.0	9.9
6992: Modelling with Calculus	111	102	55.2	18.8

		Max. mark	A	B	C	D	E
Coursework Portfolio Boundary Mark	raw	51	40	32	24	17	10
	scaled	51	40	32	24	17	10
Written Paper Boundary Mark	raw	60	45	39	34	29	24
	scaled	51	38	33	29	25	20
Unit Scaled Boundary Mark		102	78	66	54	42	30

Provisional statistics for the award

	A	B	C	D	E
Cumulative %	8.5	36.9	56.0	69.5	85.1

Advanced Subsidiary award

Provisional statistics for the award (557 candidates)

	A	B	C	D	E
Cumulative %	2.9	13.6	31.2	54.6	77.7

Definitions

Boundary Mark: the minimum (scaled) mark required by a candidate to qualify for a given grade.

Mean Mark: is the sum of all candidates' marks divided by the number of candidates. In order to compare mean marks for different components, the mean mark (scaled) should be expressed as a percentage of the maximum mark (scaled).

Standard Deviation: a measure of the spread of candidates' marks. In most components, approximately two-thirds of all candidates lie in a range of plus or minus one standard deviation from the mean, and approximately 95% of all candidates lie in a range of plus or minus two standard deviations from the mean. In order to compare the standard deviations for different components, the standard deviation (scaled) should be expressed as a percentage of the maximum mark (scaled).