GCE 2003
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ASSESSMENT and QUALIFICATIONS ALLIANCE

Report on the Examination

Use of Mathematics

5351

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Advanced Subsidiary 5351

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Applying Mathematics Paper 1

Paper UOM 4/1

General

This paper proved accessible to the vast majority of candidates who appeared to be well prepared for most questions.

Candidates produced answers which were mainly well constructed and presented with careful attention paid to notation. This allowed many to gain a number of marks for both notation and mathematical argument even on occasions when their mathematics might have been less than accurate. However, only a few candidates made attempts to write careful explanations to their thinking and use notation that links one line of a mathematical argument to the next. Candidates should be encouraged to pay attention to such detail to ensure they maximise credit for those marks set aside for these aspects of mathematical communication.

Question 1

Many candidates were able to answer correctly both parts of this question although not many recognised that the fraction $e^{\frac{-h}{h_0}}$ gives 33% directly.

Question 2

This question was not done well with only a few candidates successfully giving the required air pressure in terms of e and p_0. Most evaluated the expression to give a numerical value.

Question 3

Many candidates recognised the significance of the term p_0 in terms of their graph of the function and consequently plotted a graph with a lower intercept on the vertical axis. Fewer recognised the effect that a larger value of scale factor would have on the graph of p against h. It was evident that only very few candidates realised that in answering this question it was possible to subsitute values into the function and plot a graph using their graphic calculators to assist them.

Question 4

On the whole, candidates had been well prepared for this question and could show the working necessary to derive the result in Line 2 from the statement in Line 1. Part (b) of the question was also well answered with many candidates being able to use the information given in the comprehension article to arrive quickly at answers to both parts.

Question 5

This question was only answered well by the more able candidates, who were able to combine the information given in the article with the requirement of the question to substitute values for h into the expression for p(h). A substantial number of candidates repeated the type of working that was required to answer question 6 successfully.

Question 6

Candidates coped well with this question using data from either the table or graph to find an approximate value for the data of the straight line.

Question 7

Many candidates successfully showed the graph under the general transformations required in this question, but in the final part of the question were unable to work with the values given to indicate the effect of the stretch. Only those candidates who indicated a correct numerical value were given full credit in the final part of the question.

Applying Mathematics Paper 2

Paper UOM 4/2

General

Most of this paper proved accessible to most candidates. In particular, the simulation and recurrence relation questions (questions 2 and 4) were straightforward for those candidates who were well prepared. The other two questions of the paper proved more difficult to the majority. There is evidence that candidates are becoming more comfortable with working with mathematical models and exploring how altering parameters might affect the model. There are important skills to develop.

Question 1

A disappointing number of candidates were able to give the equation of the straight line in answer to part (a), with a substantial number failing to recognise either the negative gradient or the intercept on the vertical axis.

In part (b), many candidates were able to work with the information given to show how it can be manipulated to give the quadratic required in part (i). However, answers to the rest of this part of the question often proved disappointing. Few candidates were able to solve the quadratic. Any method of solution was acceptable – it was particularly disappointing that candidates did not seem to be aware that they could use their graphic calculators to both plot the graph required in part (iii) and to give them the solutions required in part (ii). Only a few candidates were able to sketch the graph correctly, which meant that the majority were unable to make much headway with most of this part of the question.

Part (c)(i) of the question was intentionally difficult; consequently, only the best candidates were able to get the correct coefficients by completing the square. Part (c)(ii) was often answered by candidates who had been unsuccessful with part (c)(i) by using their understanding of the symmetric nature of the quadratic function.

Question 2

Many candidates appeared well prepared to answer this question.

In part (a), the majority were able to substitute the values into the equation and manipulate these convincingly to give the correct final value. However, a minority of candidates used an incorrect order of operations, resulting in their obtaining an incorrect final value.

The table in part (b) was completed successfully for both models by the majority of candidates. Some candidates did not follow the advice about the accuracy of working given on the paper and consequently arrived at incorrect final values.

Part (c) of the question was answered well by the majority of candidates. Most candidates were able to interpret the models in terms of growth of the village and were therefore able to gain credit for parts (d) and (e) of the question.

Question 3

Parts (a) and (b) of this question were answered correctly by a substantial number of candidates.

Part (c) was answered correctly by candidates using a wide range of techniques; it was encouraging to see candidates working with some confidence to explore the given model by, for example, substituting values to see the effect of doubling the magnitude of the earthquake.

In answering part (d) of this question many candidates were almost able to get the final answer but most forgot to divide by 28,000 to arrive at the correct final amplitude of vibration.

A substantial number of candidates appeared to understand the advantage of using the Richter scale but did not always have the ability to express this clearly in words to gain full credit in part (e).

In the final part of this question many candidates attempted to show the required result and recognised the link between exponent and logarithm, but not all arguments proved convincing.

Question 4

This question was answered well by many candidates who appeared well prepared for this topic. In answering part (a), the majority were able to explain the reasoning behind the allocation of two randomly generated integers to simulate a car parked for 30 minutes.

Many candidates were able to obtain substantial scores for filling information into the table in part (b) of the question. Most gained full credit for the allocation of parking time for each car, but errors started to creep in when they came to calculate the time of departure of each car. The column showing cars waiting was intended to assist candidates with their calculations – most used this to identify the label of the car waiting which was the most helpful strategy, but some used it to only state the number of cars waiting at any given time. Although such responses were given credit they did not particularly assist candidates with answering the question.

Finally, in answering part (c) of the question not all candidates were aware that the first part of the question was focussed on how they might make different assumptions when setting up the simulation so that it might more effectively reflect reality. Equally the intention of part (ii) was to probe their understanding that decisions should be based on information gleaned by using the simulation over a long period and running it a number of times, rather than explaining how the data they found could be used to make a decision.

Using and Applying Statistics (6990)

Advanced

Paper 6990/2

General

This paper contained questions that were accessible to all candidates. Those who were well versed in how to use their calculator to determine statistical measures and those who knew how to display data carefully using statistical diagrams were able to quickly gain a substantial number of marks.

It is the intention that this qualification emphasises the interpretation of data using the statistical measures and diagrams that candidates calculate and draw. Therefore, those candidates who were able to do this were able to gain better results than those who were only able to show proficiency in the technical skills of calculation and data representation.

Again, this session, there was little evidence of candidates tackling questions in an order that best suited them; there is no requirement that candidates tackle questions in the order they are set on the paper.

Question 1

This question was well done by the majority of candidates. Those who attempted to calculate the mean and standard deviation using formulae rather than the statistical functions of their calculators were often at a disadvantage as they were prone to either remembering an incorrect formula or making a slip in their calculations.

Question 2

There were some candidates who appeared unable to work with the normal distribution at all and were consequently at a considerable disadvantage as this question carried a substantial number of marks.

In answering part (a), there were relatively few candidates who *knew* that when data are modelled by a normal probability distribution approximately two-thirds of the data lie between one standard deviation of the mean. Of those who didn't know this fact, a number were able to go on to calculate the probability, although some candidates were unable to remember how to standardise the normal correctly.

Those candidates who knew how to proceed with calculations involving a normal distribution were usually able to cope with part (b). Again, candidates' inability to remember how to standardise the normal proved problematic.

Part (c) was answered successfully by many candidates who had presumably explored the information in the pre-release Data Sheet and carefully noted the statement about lengths having been rounded to the nearest millimetre.

Finally, part (d) was relatively well answered with many candidates being aware that the leaf data represented only a small sample of the population.

Question 3

A substantial number of candidates gained full marks on this question. However, it was disappointing to see a substantial number of candidates plotting cumulative frequency values at the mid-points of the intervals. Unfortunately, a number of candidates produced bar charts or histograms of the data.

Of those candidates who had a workable cumulative frequency diagram, most were able to indicate where the quartiles are to be found but some related these to the cumulative frequencies rather than the corresponding data values.

Question 4

Those candidates who could use their calculators efficiently to determine the statistical measures of mean, correlation coefficient and coefficient of the equation of the line of best fit were successful with most of this question.

The majority of candidates knew that the line of best fit should pass through the mean point and that the equation of the line gives the intercept on the vertical axis and were therefore able to gain full credit for part (b). Many candidates were able to answer the first part of (c) by either using their equation correctly or their graph accurately. Fewer understood that because a fish of mass 1.4 grams is considerably outside the range of masses of the sample, it is inadvisable to use the line of best fit to predict the length of this fish. Part (d) was well answered by many candidates who were able to interpret the correlation coefficients and compare them. However, some candidates only interpreted the correlation coefficient given and did not make a comparison.

Question 5

This question was done well by a majority of candidates who had obviously spent time in advance of the examination making sense of the diagram.

However, in answering part (c), a number of candidates did not appear to understand the significance of the cumulative values being plotted on each axis, and attempted to interpret the curve in terms of a function.

Question 6

Although this question only required candidates to calculate percentage increases and carry out reverse percentage calculations, it did prove relatively difficult. Perhaps this was because of the data values involved.

Part (c) was relatively well answered, with many candidates being able to see why the population did not remain the same and being able to put an adequate explanation into words.

Working with Algebraic and Graphical Techniques (6991)

Advanced

Paper 6991/2

General

This paper was accessible to candidates, with many showing that they were well prepared. They had adequate time to complete the examination, and the standard of presentation was good. The graphical questions were better attempted than the algebraic questions. Trial and improvement was a common method of solving any equation, with the consequent gamble of gaining all or no marks. There were fewer weaker candidates this year compared with last year.

Question 1

Most could draw the graph correctly in part (a) and give the three correct answers in part (b). Weaker candidates could not do parts (c) and (d). In part (c), answers such as $(x-20)^2+500$ or $(x-10)^2+600$ or $(x-4.47)^2+500$ were seen. In part (d), many gave p correctly but were unable to identify the connection for q.

Question 2

Most got parts (a) and (b) correct. In part (c), those who got the values of a and b from the gradient and intercept were more likely to be correct than those who attempted to find a and b by setting up two simultaneous equations. Some gave a as the intercept and b as the gradient. Most scored well on parts (d) and (e) on following through with their equation from part (c). Part (f) was mostly very badly done, with many mentioning intercept and gradient, or failing to give the numbers linked with the stretch and translation, or giving the translations in the incorrect order.

Question 3

Most did parts (a)(i) and (ii) correctly, but some did not use the graph to explain their answer to part (a) (iii) or stated that the model gave negative values around $t = 7$ or $t = 8$. Part (b) (i) was done well with many correct answers from trial and improvement. Part (b)(ii) was less well answered, with many dividing by 1657 or 1658 rather than by 1700, and some forgetting to multiply by 100. Part (c) was badly answered, with most not drawing a tangent, and often even those who drew a tangent failed to give a negative answer. Some gave "degrees" and "angle" as their answers for parts (c)(ii) and (iii). Part (d) was done better than part (c), but some did not sketch two graphs and just stated that $V = k / t$ was the better model.

Question 4

The drawing of the trigonometric graph in part (a) was done better this year than in previous years, but some only plotted 3 or 4 points rather than the 7 points indicated on the horizontal axis on the answer sheet. Parts (b), (c) and (d) were done well provided the graph was correct. Trial and improvement was again used for both parts (e) and (f), often successfully for part (e) but never for part (f). Candidates often picked up marks in part (f) for showing the correct method even though their answers were incorrect.

Modelling with Calculus (6992)

Advanced

Paper 6992/2

General

The majority of candidates entered for this paper found the examination to be of a suitable length; they were able to show their skills in the straightforward parts of the questions. A few candidates achieved low marks and these must have found the course an unrewarding experience. Questions three and four proved to be good discriminating questions.

Question 1

In general this question was well answered. Most, in part (a), attempted to solve $\frac{1}{400\,000}\left(3\,400\,000 - 2000x^2\right) = 0$, but candidates showed that their greatest difficulty was in writing down the coordinates of A and B. Part (b) was attempted well but few simplified their answer to $0.85 - 0.001x$. Those who were successful in part (b) usually found no problems with parts (c), (d) and (e).

Question 2

The differentiation required in part (a) (i) was normally completed successfully. Part (a) (ii) caused problems, usually either because the answer obtained in part (a)(i) was not identical to that quoted, which was $2t^3 - 6t^2 + 5t - 1$, or because candidates attempted to solve $2t^2 - 4t + 1 = 0$. Part (a) (iii) was often correct, but many used the cubic quoted in part (a) (ii) rather than their answer to part (ii) as required. The solution to the quadratic $2t^2 - 4t + 1 = 0$ was frequently correct and the explanation in part (a) (v) was also usually correct. Many candidates gave the correct answer to the integration in part (b) but some did not appreciate that their answer of $\frac{2}{15}$ was in thousands and therefore the average number of birds was 133. Few gave an appropriate explanation in part (c); the fact that the formula, when $t = 6$, gave a negative number of birds, was quite appropriate!

Question 3

Many candidates could not differentiate or integrate $\sin\pi t$. In part (a), candidates simply had to insert the values $t = 0$ and $t = 0.1$ into $0.05\sin\pi t$. However, candidates usually worked in degrees and failed to make progress. Many who did use radians were often able to complete the differentiation and integration correctly and thus were usually able to complete the question correctly.

Question 4

A small proportion of candidates knew and could use the product formula for differentiation and these were usually able to obtain the quoted formula. Most candidates, however, ignored part (a) and started at part (b). Only one or two attempted the second differentiation of $100x^2e^{-2x}$, and these were usually correct. Most candidates appreciated that the logical method involved finding the value of $\frac{dy}{dx}$ to the left and the right of $x = 1$. Part (c) was usually answered correctly, often from the given graph, which was accepted. The trapezium rule in part (d) was well known by candidates and many correctly found the average number. Premature truncating or rounding often prevented candidates from achieving the accuracy required.

Coursework Portfolios

Advanced

It was noticeable that once again this year there was 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.

It was pleasing to note that most of the centres assessed their work within the approved tolerances. The major concern was that 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.

There was, however, evidence that a few centres were awarding their candidates marks which were too high. Particularly in 6990 'Using and Applying Statistics', high marks were awarded for work which included little material of an AS standard. Marks of over forty out of fifty should only be awarded for work which is of a grade A standard at AS level. These portfolios should show competence in dealing with the difficult parts of the specification, including the normal distribution and at least one of the 'extension possibilities'.

It was noticeable that centres differed widely on the amount of annotation which they gave to the work. Annotating the work is helpful to candidates as it provides them with feedback which can often identify which parts of the criteria they need to include within the next part of their portfolio.

The problem which did arise in the portfolios was in *Theme 2: Using Appropriate Mathematics and Working Accurately.* It was noticeable that the trend that began last year continued; candidates attempted to show more explicit checking. However candidates still found difficulty in showing clearly where checking had taken place.

If the same tasks are to be used in more than one unit, it is essential that the tasks are assessed separately and it is confirmed that the specification for each unit is satisfied. For example, if one task is included in both 6991 'Working with Algebraic and Graphical Techniques', and 6992 'Modelling with Calculus', a high grade in 6991 does not imply that a high grade is appropriate in 6992 unless the calculus requirements are all met competently.

It was noticeable that the paperwork this session was often completed correctly. The administrative arrangements regarding CMS forms caused minor difficulties; only one or two centres sent only one copy, and a few centres did not send the completed centre's internal moderation form.

Mark Ranges and Award of Grades

UoM4 Applying Mathematics (260 candidates)

Unit/Component	**Maximum Mark (Raw)**	**Maximum Mark (Scaled)**	**Mean Mark (Scaled)**	**Standard Deviation (Scaled)**
Applying Maths I UoM 4/1	30	30	11.3	7.3
Applying Maths II UoM 4/2	70	70	22.7	11.9
Applying Maths UoM4	100	100	34.0	17.5

		Max. mark	A	B	C	D	E
Paper I Boundary Mark	raw	30	21	18	16	14	12
	scaled	30	21	18	16	14	12
Paper II Boundary Mark	raw	70	48	42	36	31	26
	scaled	70	48	42	36	31	26
Unit Scaled Boundary Mark		100	69	60	52	45	38

Provisional Statistics for the Award (260 candidates)

	A	B	C	D	E
Cumulative %	3.1	10.8	26.5	46.9	70.4

6990 Using & Applying Statistics (286 candidates)

Unit/Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
6990/1: Coursework Portfolio	51	51	26.1	9.9
6990/2: Written Paper	60	51	23.9	9.6
6990: Using & Applying Statistics	111	102	50.0	16.9

		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	48	42	37	32	27
	scaled	51	41	36	31	27	23
Unit Scaled Boundary Mark		102	81	68	55	44	33

Provisional Statistics for the Award (286 candidates)

	A	B	C	D	E
Cumulative %	3.1	14.0	32.2	53.8	79.7

6991 Working with Algebraic & Graphical Techniques

(340 candidates)

Unit/Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
6991/1: Coursework Portfolio	51	51	25.6	10.3
6991/2: Written Paper	60	51	27.1	9.5
6991 Working with Algebraic & Graphical Techniques	111	102	52.8	16.9

		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	38	33	29	25
	scaled	51	37	32	28	25	21
Unit Scaled Boundary Mark		102	77	64	52	42	31

Provisional Statistics for the Award (340 candidates)

	A	B	C	D	E
Cumulative %	7.9	23.2	45.9	69.4	83.8

6992 Modelling with Calculus (91 candidates)

Unit/Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
6992/1 Portfolio	51	51	28.2	10.3
6992/2 Written Paper	60	51	17.3	9.5
6992	111	102	45.6	16.3

		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	65	53	42	30

Provisional Statistics for the Award (91 candidates)

	A	B	C	D	E
Cumulative %	2.2	9.9	26.4	54.9	79.1

Advanced Subsidiary award

Provisional statistics for the award (260 candidates)

	A	B	C	D	E
Cumulative %	3.1	10.8	26.5	46.9	70.4

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).

Uniform Mark: a score on a standard scale which indicates a candidate's performance. The lowest uniform mark for grade A is always 80% of the maximum uniform mark for the unit, similarly grade B is 70%, grade C is 60%, grade D is 50% and grade E is 40%. A candidate's total scaled mark for each unit is converted to a uniform mark and the uniform marks for the units which count towards the AS or A-level qualification are added in order to determine the candidate's overall grade.