GCE 2002
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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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Kathleen Tattersall, Director General

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Use of Mathematics

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Applying Mathematics Paper 1

Paper UOM4/1

General

This was the first time that this paper had been set and in general candidates worked well with the comprehension article, as given in the pre-released Data Sheet. There was evidence that candidates had prepared well by being fully familiar with the article. Presentation of mathematics was good by the strongest candidates, with many gaining 2 or 3 of the marks available under each of the allocations for use of notation and development of clear and logical mathematical arguments. As may be expected, weaker candidates who did not gain many marks for correct working also did not gain many marks under these headings, as their work was of a poor quality overall. Candidates should be encouraged to make sure that sketch graphs are labelled and that units are given with answers. Candidates should also be encouraged to make sure that their work is presented using linking notation and symbols as well as words.

Question 1

Most candidates produced the sketch graphs required, but a significant number of candidates did not ensure that each had the same intercept on the y – axis. On this occasion, this was not penalised. A number of candidates did not produce sketch graphs over the required domain (i.e. $-2 < x < 2$) and gave sketches for only $x > 0$. In part (ii), a substantial number of candidates were unable to identify the correct condition for k for the function to model exponential growth.

Question 3

In general this was answered well by many candidates. However a number considered that since $\ln N_0 = 2$, then $N_0 = 2$.

Question 4

In part (a), some candidates found P_1 using $P_0 = 9.6$ as given, and then went on to find P_2 using the value of Biomass after 1 hour, given by the table on the Data Sheet, rather than working with the value that they had just calculated. Some candidates did not work to the required degree of accuracy to ensure that their answer was given to the required four significant figures.

Question 5

Many candidates were able to give an explanation that when the population is large the term in brackets tends to zero. However, only a minority of candidates showed that this becomes increasingly significant by contrasting this with when the population is smaller.

Question 6

Many candidates gained some credit for their understanding of the logistic model which was tested by this question. Part (b) was well answered with many candidates correctly quoting reasons, as given in the final paragraph of the Data Sheet.

Applying Mathematics Paper 2

Paper UOM4/2

General

This was the first sitting of a paper for this examination component and many candidates made a successful attempt at it. There was some evidence that candidates worked through questions on the paper in order and they may be better advised to seek out questions with which they are most comfortable and do these first. Candidates should be encouraged to sketch graphs where this is required rather than plotting on graph paper. Their sketches should show all significant details such as where functions intercept axes.

Question 1

Part (a) was answered well by many candidates. In part (b), a number of candidates did not, as requested, use their answers to part (a) to deduce where astronomers looked in the early 1800s for a planet. Some candidates did not give their answer in millions of miles as requested in part (b)(ii).

Question 2

Although the formula quoted for windchill might have appeared daunting, many candidates worked with it successfully. In part (b)(ii), candidates were asked to sketch a graph of $T_w = 1.35T - 11.55$. In such cases candidates should be encouraged to not only show a straight line but also give its intercepts with both horizontal and vertical axes. A substantial number of candidates plotted accurate graphs when a sketch would have sufficed. In part (v), many candidates gave good interpretations of the significance of the point where the two lines intersected on their sketch graph.

Question 3

In part (a), many candidates were able to interpret the delay in the start of the graph and the shape of the graph in terms of the real situation. For part (b), the majority of candidates were unable to state the value of b and clearly did not understand how this is related to the shift of the minimum point of the quadratic model along the horizontal axis. Part (c) was only answered well by a small minority of candidates, with very few showing any understanding of how geometrical transformations can be applied to a function. Part (d) was also not well answered with some candidates working with points on the line other than those given.

Question 4

The early parts of this question were well done by many candidates, who successfully used the recurrence relation to calculate the values required and draw a graph of the amount the house buyer owes at the end of each year. However, many candidates were only able to interpret the shape in general terms and were unable to explain why it had its shape in terms of the given situation.

Question 5

Those candidates who were able to tackle this question with any confidence often gained full marks for parts (a) and (b). In answering part (c), which asks how the simulation may not adequately model the situation, candidates should be encouraged to look at the assumptions that were made in setting up the model and question the validity of these.

Coursework Portfolios (6990, 6991, 6992)

Advanced

General

It was noticeable that 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, possibly as a result of the standardisation meetings, virtually all centres assessed the work within approved tolerances. The only concern was that a few centres gave their candidates tasks which were too structured and this prevented some candidates from being able to show their individual skills and initiative.

However, 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 and this can often identify which parts of the criteria they need to include within the next part of their portfolio.

There was a wide variation in the quality of portfolios submitted from those, the vast majority, who produced excellent work, to a few candidates who showed little enthusiasm for their study.

The main problem which did arise in the portfolios was in Theme 2, Using Appropriate Mathematics and Working Accurately. Candidates found it difficult to show explicitly where checking had taken place. However, it was noticeable that candidates were attempting to show more explicit checking than in previous years.

Administration

The paperwork this session was often completed correctly. The administrative arrangements regarding CAM 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.

Using and Applying Statistics (6990)

Paper 6990/2

General

Candidates should be encouraged to answer questions in the order they prefer; there is no requirement for them to answer questions in the order in which they are set.

Some candidates obviously spent a considerable amount of time tackling questions for which there were very few marks in relation to their efforts. Candidates should be advised to bear in mind the number of marks allocated to each question part, and that these give an indication of the amount of time they might expect to spend on any question and also an indication of the level of difficulty of method they should use.

Question 1

A number of candidates went beyond the quick *sketch* that was required in part (a); in the worst cases candidates re-plotted the data on graph paper.

Part (b) proved difficult for those candidates who either worked with the whole data set rather than the restricted set that was required or who did not use the statistical functions of their calculators to quickly find the statistical measures required. Candidates must read the question carefully as it was made as clear as possible that they were only expected to work with data for the years 1980-1987 inclusive. Those who worked with the whole data set were not overly penalised but they did waste a considerable amount of their time – a substantial number of those who did this worked correctly. Candidates who had managed to calculate the measures required in part (b) were in many cases able to answer the remaining parts of the question well.

Question 2

This question, although only requiring candidates to work with data from a table which they had been presented with in advance on the Data Sheet proved difficult for many candidates. Those who recognised the subtle difference between percentages being quoted and the actual number of motorists in each case were perhaps most successful.

In part (d), candidates were required to think about representative samples. Many candidates seemed unprepared for this, instead referring to the fact that the motorists questioned after the installation of speed cameras should be the same as those questioned before. Candidates should have been thinking about the idea of how a representative sample allows the gathering of adequate information.

Question 3

The reverse percentage calculation required in part (b) was badly done by many, if not most, candidates.

Question 4

A surprising number of candidates did not draw adequate cumulative frequency diagrams. Common errors included plotting cumulative frequencies at 4.5, 9.5, 19.5 years and so on, or at the mid-point of the intervals. Most candidates were able to correctly find and indicate estimates of the ages of the 10^{th} and 90^{th} percentiles using their graph.

Question 5

This question was not tackled by all of the candidates, indicating that it was a topic with which some were not comfortable, and that others had already used their time allocation.

Only a minority of candidates were able to work with the information given to calculate the standard deviation in part (b).

Those candidates who were able to visualise the information given in parts (c) and (d) on sketches were invariably able to go on and calculate using the Normal Distribution tables correctly.

Working with Algebraic and Graphical Techniques (6991)

Paper 6991/2

General

This paper was accessible to candidates with many showing that they were well prepared. The candidates had adequate time to complete the examination. The graphical questions were better attempted than the algebraic questions, but the algebraic questions were done better this year than last year. There were fewer weaker candidates this year compared with last year. Some candidates did not give their answers to 3 significant figures. Most candidates scored better on the first two questions than they did on the last two questions.

Question 1

Most candidates could draw the graph correctly in part (a). In part (b), some candidates gave the wrong units, using £ for all four answers.

Part (c) was done better this year but some candidates wrote down $(x-60)-500$. Most candidates interpreted a and b correctly in part (d), in terms of the maximum profit and its price, but some said it gave the coordinates of the turning point.

Question 2

Most candidates completed parts (a) and (b) correctly. Most candidates plotted the points for the graph in part (c) but some did not draw a line through the points, or drew a line from $x = 12$ to $x = 20$.

Some candidates did not do part (e) but used their line from part (c) to incorrectly make predictions for part (f).

Part (h) was usually interpreted well with $y = k\sqrt{x}$ sometimes given as the preferred model instead of $y = k\mathrm{e}^{x}$.

Question 3

The algebraic proof in part (a) was done better this year. Most candidates did parts (b) and (c) well, with only a few not giving the answers to 3 significant figures, or using log instead of ln. In part (d), most candidates got $\ln d = 6.66$ but some gave the final answer as 8.3 instead of $e^{8.3}$

Most candidates obtained the gradient in part (e) but some did not use the prompt given on the answer sheet to start the axes at the origin, and so then often got $\ln k$ wrong by reading it as the intercept on the $\ln T$ axis with their incorrectly labelled axes. Some candidates got $\ln k$ and n correct but then wrote down $y = 1.5x - 1.6$ instead of $\ln T = 1.5 \ln d - 1.6$.

Part (e)(ii) was beyond most candidates, with most assuming it was the same as part (e)(i).

Question 4

Most candidates did part (a) well. Some candidates did not give the "3 times" for part (a)(i) and some tried to solve equations for (a)(i) and (a)(ii) instead of just reading off the answers from the graph. Most candidates drew a tangent line in part (a)(iii) but some made mistakes in reading the values from the scales.

In part (b), some candidates just guessed an answer of 7 hours and some just gave the times when the water depth was 6 metres without subtracting them.

Part (c) was found to be difficult by most candidates, with some poor algebra such as $10 \cos(30t) = 5$ or $\cos t = \frac{-2}{(3\text{x}30)}$. There were very few correct answers to part (d), with some candidates referring to frequency, phase, compression or scaling. The d translation of +7 was sometimes seen but the one way stretches were rarely given.

Modelling with Calculus (6992)

Paper 6992/2

General

Candidates found this paper accessible. They were able to show their strengths and found the paper to be of an appropriate length. On the majority of scripts, questions 1 and 4 were completed correctly, whereas questions 3 and 5 (a) were found to be the most challenging. Encouragingly, very few candidates achieved single figure totals on this paper, whilst a number achieved over forty marks out of the possible sixty.

Question 1

(a)(i) 7m *(ii) – 65* *(b) 12 – 10t* *(c) 1.2*
(d) 7.2m *(e)(i) – 10* *(f) 0.2, 2.2*

This question was attempted well, with most candidates scoring ten or more marks. Part (a)(i) and the height in part (a)(ii) were usually correctly found but many candidates could not state what $y = -65$ meant in real terms.

Answers to parts (b), (c) and (d) were generally correct and most candidates appreciated what was needed in part (e). A few numerical errors affected answers in this question. In part (f), most found when $12 - 10t = +10$, but only a few also solved $12 - 10t = -10$.

Question 2

$x = 4t - 0.05t^2$

Most candidates realised that they needed to integrate $4 - 0.1t$. Unfortunately, many forgot either the $+ c$, with the need to prove that $c = 0$, or to divide 0.1 by 2 to obtain 0.05.

Question 3

(a) $\dfrac{dV}{dt} = \dfrac{5\pi}{18}\cos\dfrac{\pi}{180}(t-110)$ $\qquad \dfrac{d^2V}{dt^2} = -\dfrac{5\pi}{18}\times\dfrac{\pi}{180}\sin\dfrac{\pi}{180}(t-110)$

(b) $\dfrac{5\pi}{18}$

This question was found to be challenging by many candidates. Finding the differential of $\sin\dfrac{\pi}{180}(t-110)$ proved too difficult for many candidates; some did not know that the differential of sin t is cos t and some candidates could not resist the temptation to change $80 + 50\sin\dfrac{\pi}{180}(t-110)$ into $130\sin\dfrac{\pi}{180}(t-110)$.

Question 4

(*a)(i) 6.20 am (ii) 1.48 – 0.24h (iv) 2 pm*

(b)(i) 15.6 (ii) 61.71 (iii) the curve is concave between h = 2 and h = 6 so both trapezia include areas outside the curve.

This question was answered well. Most candidates completed part (a) successfully. Parts (b)(i) and (b)(ii) were answered well; in part (b)(i) a common error in a number of scripts was to simplify the values of T to 14, 15 and 18 rather than using the four figure values as required. In both parts (b)(i) and (b)(ii), the division by 4 used in converting the integral into the mean appeared randomly. Candidates were not penalised for dividing their answer to part (b)(ii) by this four. There were few convincing explanations as to why the trapezium rule gave an overestimate.

Question 5

(a)(i) $m = Ae^{kt}$ *(ii)* $m = 40e^{kt}$ *(b)* $\frac{1}{3}\ln 2$ *(c) 640*

Part (a) was attempted badly. Very few candidates converted $\frac{dm}{dt} = km$ into $\int\frac{dm}{m} = \int k\,dt.$ Part (b) was completed much more successfully but many candidates used k as 0.23 rather than 0.231... This gave a substantial inaccuracy in part (c). No candidate used the fact that the mass when t = 12 could be obtained by using the statement that every three days the mass doubled, and applying this doubling four times.

Mark Ranges and Award of Grades

UOM4 Applying Mathematics

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Written Paper UOM4/1	30	30	14.2	6.7
Written Paper UOM4/2	70	70	29.5	13.7

Grade	Max. Mark	A	B	C	D	E
UMS	100	80	70	60	50	40
Boundary Mark UOM4/1	30	23	20	17	14	12
Boundary Mark UOM4/2	70	53	46	40	34	28

Provisional statistics for the qualification as a whole (71 candidates)

	A	B	C	D	E
Cumulative %	4.2	12.7	42.3	69.0	85.9

6990 Using and Applying Statistics

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Coursework Portfolio 6990/1	51	51	27.1	10.1
Written Paper 6990/2	60	51	16.2	7.2

Grade	Max. Mark	A	B	C	D	E
UMS	100	80	70	60	50	40
Scaled Boundary Mark 6990/1	51	40	32	24	17	10
Boundary Mark 6990/2	60	44	38	32	27	22

Provisional statistics for the qualification as a whole (122 candidates)

	A	B	C	D	E
Cumulative %	0.8	9.0	28.7	53.3	83.6

6991 Working with Algebraic and Graphical Techniques

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Coursework Portfolio 6991/1	51	51	31.3	10.9
Written Paper 6991/2	60	51	27.5	8.8

Grade	Max. Mark	A	B	C	D	E
UMS	100	80	70	60	50	40
Scaled Boundary Mark 6991/1	51	40	32	24	17	10
Boundary Mark 6991/2	60	45	39	34	29	24

Provisional statistics for the qualification as a whole (143 candidates)

	A	B	C	D	E
Cumulative %	14.0	34.3	58.7	77.6	92.3

6992 Modelling with Calculus

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Coursework Portfolio 6992/1	51	51	33.7	10.1
Written Paper 6992/2	60	51	20.1	9.2

Grade	Max. Mark	A	B	C	D	E
UMS	100	80	70	60	50	40
Scaled Boundary Mark 6992/1	51	40	32	24	17	10
Boundary Mark 6992/2	60	47	41	35	29	24

Provisional statistics for the qualification as a whole (65 candidates)

	A	B	C	D	E
Cumulative %	7.7	20.0	53.8	83.1	90.8

Definitions

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

Mean Mark: the sum of all candidates' marks divided by the number of candidates. The mean (or average) mark measures a central tendency of a mark distribution (provided that the distribution is not skewed).

Standard Deviation: a measure of how widely candidates' marks are spread about the mean mark. When expressed as a percentage of the Maximum mark (scaled), small standard deviations indicate that the marks are "bunched" and large standard deviations indicate a wide spread of marks. In general, the marks of approximately two-thirds of all candidates lie in a range of plus or minus one standard deviation about the mean mark.