2005 Mathematical Methods GA 3: Written examination 2

GENERAL COMMENTS

17 041 students presented for the Mathematical Methods examination 2 in 2005, compared with 17 990 in 2004. An acceptable proportion of students achieved a perfect score, but a disappointing number received less than five marks out of the 55 available.

There was clear evidence of poor use of graphics calculators, which sometimes led to answers that were incorrect in the last decimal place. Use of the TRACE button still occurred, despite repeated comments in previous years' Assessment Reports that this should **not** be used.

Many students demonstrated poor mathematical notation and algebra skills, with a large number apparently heavily reliant on their calculator.

As in previous years, students were required to show working for any question worth more than one mark. Some students lost several marks over the whole paper because they did not do this. It is important that students know that they are required to show their working. Similarly, many students lost marks because they did not write a correct derivative (in Questions 3fiv. and 4c.) or antiderivative (in Question 3e.) when the question instructed them to 'use calculus'.

Many students lost marks needlessly because they did not answer the specific question asked, and many gave the wrong number of decimal places or gave a decimal answer when an exact answer was required.

SPECIFIC INFORMATION

Question 1

1ai.

Marks	0	1	Average
%	70	30	**0.3**

(0, 2]

1aii.

Marks	0	1	2	Average
%	20	35	45	**1.3**

Domain = (0, 2]

$y = \log_e\left(\frac{2}{t}\right)$

1bi.

Marks	0	1	2	3	Average
%	34	8	11	48	**1.8**

$b = 4$, $c = -3$

1bii.

Marks	0	1	2	Average
%	39	18	44	**1.1**

$m = 3$, $n = e^{-3}$, $p = 0$

1biii.

Marks	0	1	2	Average
%	48	21	31	**0.8**

$(1, -5)$, $(3, 8e^{-3} - 5)$

1ci.

Marks	0	1	2	3	Average
%	75	4	5	16	**0.6**

$a = \pm 6$

1cii.

Marks	0	1	2	Average
%	88	5	7	**0.2**

$-6 < a < 6$

A common incorrect answer for part ai. was $(0, \infty)$, which indicated that students did not consider the domain of the function. A surprising number of students did not give a domain for part aii., perhaps because they had not read the question properly. However, many gave the same answer as they gave for part ai., indicating that they understood that the domain of the inverse is the same as the range of the function.

Many students made algebraic errors part bi., but it was pleasing to see frequent good use of the product rule. Students who used transformations for part biii. were generally successful; however, the approach from substitution and recalculation of turning points was time-consuming and open to algebraic errors.

In part ci., students needed to recognise the need to find the discriminant; those who did this usually made good progress. However, a number of these students did not try to use the discriminant in part cii. and often failed to obtain any marks. A few students realised that the easiest way to determine the correct interval was to sketch a graph.

Question 2

2a.

Marks	0	1	2	3	Average
%	14	5	13	68	**2.4**

0.412, 0.393, 0.019

2b.

Marks	0	1	Average
%	58	42	**0.4**

75.03

2c.

Marks	0	1	2	Average
%	65	14	21	**0.6**

0.401

2d.

Marks	0	1	2	Average
%	43	11	46	**1.1**

$1060

2ei.

Marks	0	1	Average
%	38	62	**0.6**

$5310

2eii.

Marks	0	1	2	Average
%	39	11	50	**1.2**

0.338

2eiii.

Marks	0	1	Average
%	47	53	**0.5**

2.06

2eiv.

Marks	0	1	2	3	Average
%	78	9	5	8	**0.4**

0.101

Question 2 highlighted students' weaknesses in rounding decimals. Students should be aware that it is important to use numbers containing more decimal places than required when calculating new answers based on previous ones. For example, students should have worked to four or five decimal places in part ei., since the answer was obtained by multiplying the answer to part d. by 5. An easy way to keep track of accurate answers to early parts of the question is to store them in the graphics calculator memory. Students should practise doing this before the examination.

Part a. was the easiest question on the paper, as shown in the statistics; however, some students were careless and wrote 0.187 instead of 0.019 for the last answer. Too many students got the answer for part b. from the 90th percentile rather than the 10th percentile. Common sense should have warned them that a conceptual error had been made, as it is not reasonable that 90 per cent of his throws are greater than the mean.

More students recognised the conditional probability in part c. than in previous years, but a number of them then used 0.412 instead of 0.393 and got an incorrect answer. Arithmetic proved to be a major problem in part d., while other errors also arose from using 0.412 instead of 0.5 – 0.412 for the probability of throwing between his personal mean and the A standard.

Parts ei., eii. and eiii. were generally well done, although a few students lost a mark because they incorrectly expected the answer to part eiii. to be an integer. Part eiv. proved too difficult for most students. It was necessary to recognise that Tasmania could achieve a reward of at least $10 000 in **two** ways: with one throw greater than the Olympic record (combined with any other throws) **or** with five throws greater than the A standard but less than the Olympic record.

Question 3

3a.

Marks	0	1	Average
%	15	85	**0.9**

150

3b.

Marks	0	1	Average
%	13	87	**0.9**

50

3ci.

Marks	0	1	Average
%	18	82	**0.8**

800 m

3cii.

Marks	0	1	Average
%	18	82	**0.8**

400 m

3d.

Marks	0	1	2	Average
%	34	17	49	**1.2**

716 m

3e.

Marks	0	1	2	3	Average
%	27	39	11	23	**1.3**

13 080 m^2

3fi.

Marks	0	1	Average
%	70	30	**0.3**

$800 - 2k$

3fii.

Marks	0	1	Average
%	74	26	**0.3**

$400 + 2k$

3fiii.

Marks	0	1	Average
%	67	33	**0.3**

$(800 - 2k)^2 + (400 + 2k)^2$

3fiv.

Marks	0	1	2	Average
%	76	8	16	**0.4**

100

As the statistics show, there was general success in obtaining the first four marks for this question (Questions 3a–cii.), indicating that students were generally capable of using a graphics calculator for this type of situation.

In part d. it was necessary to get two values of x from a graphics calculator and find their difference; students who did not get full marks usually found only one value or subtracted incorrectly. The line $y = 20$ drawn on the graph would have helped students to use the correct functions of their graphics calculators.

Part e. required the use of calculus to be demonstrated by a correct antidifferentiation, which was frequently poorly done. While one mark could be obtained for writing the correct expression as an integral, an incorrect antiderivative precluded any more marks being awarded. Incorrect statements concerning negative signs (for example, Area = –13080 = 13080) were penalised.

The hardest part in answering part f. was in working out what was required – the actual mathematics was quite straightforward. Those who understood the question and correctly answered the first two parts usually gained most of the marks.

Question 4

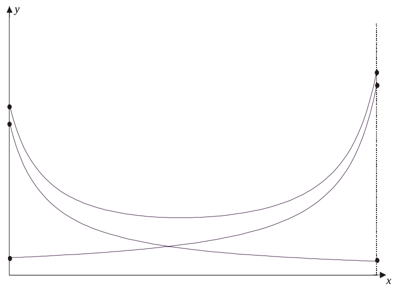
4a.

Marks	0	1	Average
%	25	75	**0.8**

$y = \frac{p}{4} + \frac{q}{9}$

4b.

Marks	0	1	2	Average
%	49	15	36	**0.9**



4c.

Marks	0	1	2	Average
%	52	24	25	0.7

$$\frac{-9}{(x+1)^2}+\frac{4}{(11-x)^2}=0$$

4di.

Marks	0	1	2	3	Average
%	53	20	10	18	0.9

$x = 6.2$, $y = 2.083$

4dii.

Marks	0	1	Average
%	80	20	0.2

9.044 km

4e.

Marks	0	1	2	Average
%	65	6	29	0.6

31.17

Part a. was generally handled well except for some arithmetic errors. A number of students who had otherwise done well did not attempt part b., perhaps because they had misread the question as there was no space given for an answer. Of those students who did attempt this part, many did not clearly indicate the end-points and some had the new graph intersecting one of the others. It is recommended that graphs be drawn in pencil as single, smooth continuous curves.

Answers to part c. were often marred by careless errors, particularly with signs, and by a failure to equate the derivative to zero. Some students tried to solve this equation in part c instead of part di.

Careless errors were also frequent in part di., and a number of students forgot to find a value for *y*. The most common error made in answering part dii. was ignoring the domain of the function and finding the difference in the *x* value of two intersection points (9.088 km), instead of one of these and 10.

Part e. required a correct antiderivative to gain any marks. Again sign errors abounded. Students who gave a correct answer, presumably obtained from a graphics calculator, but no antiderivative (or an incorrect one) gained no marks.