GENERAL COMMENTS

The number of students who sat for the 2001 examination was 17 487, which was 3.37% more than the 16 898 who sat in 2000. Almost 14.6% scored 90% or more of the available marks (compared with 7% in 2000) and 282 receiving full marks, compared with sixteen in 2000.

The overall quality of responses was similar to that of recent years. There were many very good responses and it was rewarding to see the quite substantial number who worked through questions completely to obtain full marks. However, the percentage who scored very few marks and who appeared to attempt little or nothing in Part 2 continues to cause concern. There seems to be little evidence to suggest that not making a reasonable attempt on Part 2 is due to lack of available time.

Students should be made familiar with instructions such as:

- a decimal approximation will not be accepted if an exact answer is required to a question
- where an exact answer is required to a question, appropriate working must be shown
- where an instruction to **use calculus** is stated for a question, you must show an appropriate derivative or anti-derivative.

Students should consider carefully what they include in the pre-written notes that may be brought into the examination. Based on comments from previous Report to Teachers, these might cover matters such as the difference between sampling with and without replacement, with an example of each, solutions to typical circular functions and other equations, key points for integration and differentiation, reminders of key features for the sketching of curves, axial intercepts, turning points and asymptotic behaviour, and reminders of how graphics calculator functions can be used to find intersections between graphs, intersections of graphs with the axes and evaluate derivatives and integrals.

Students undertaking mathematics at the Year 12 level should have a clear understanding of the difference between an undetermined constant and a variable. However, responses in Questions 2 and 4 suggested that this was not the case.

Graphical interpretation should be highlighted as an area that would benefit from further attention, with relatively poor responses to Questions 7 and 22 in Part 1. Responses to Question 7, although much improved from the similar question in 2000 were still disappointing, since the question tested the same concepts and skills to those in Part 1, Question 1 of the 2000 examination. As noted in previous reports, there were problems associated with poor algebraic skills, setting out and use of mathematical notation. There continues to be a gradual improvement each year in the effective use of graphics calculators.

Some students still have difficulty in expressing an answer to a specified accuracy.

Part 1 – Multiple-choice questions

The third column gives the percentage of correct responses.

Question	Correct response	%	Question	Correct response	%
1	**E**	90	15	**A**	71
2	**C**	90	16	**A**	75
3	**B**	61	17	**C**	67
4	**E**	64	18	**A**	51
5	**E**	46	19	**C**	60
6	**A**	41	20	**E**	39
7	**A**	36	21	**C**	50
8	**B**	72	22	**B**	34
9	**C**	52	23	**B**	49
10	**E**	88	24	**A**	74
11	**C**	84	25	**E**	53
12	**E**	68	26	**B**	70
13	**A**	67	27	**D**	64
14	**A**	68			

Part 2

GENERAL COMMENTS

Question 1

a. (Average mark 1.03/Available mark 2)

Correct response:

$X \sim \text{Bin}(3, 0.6)$

$\Pr(X = 2) = {}^3C_2(0.4)(0.6)^2$

$= 0.432$ (or $\frac{54}{125}$)

b. (1.35/2)

Correct response:

$Y \sim \text{Hg}(3, 6, 10)$

$\Pr(Y = 1) = \frac{{}^6C_1 x\, {}^4C_2}{{}^{10}C_3}$

$= 0.3$

There was quite a deal of uncertainty as to whether to use the binomial distribution or hypergeometric distribution in each part. Quite a few used the hypergeometric distribution in part a. and the binomial distribution in part b. Some who realised that in part a. the binomial distribution applied, used $n = 10$ rather than $n = 3$, as well as values of p such as $\frac{2}{3}$ and 0.4. Other students were not sure about what constituted ‘defective’; in this case ‘live’ corresponded to ‘defective’. This affected the student’s choice of p in part a and D in part b. A small number of students used the same distribution in both parts. Others worked in too much of a hurry, using $D = 4$ and/or $Y = 2$ in part b. More students achieved full marks in part b than in part a.

Question 2

a. (0.48/1)

Correct response: $2(x + 3)^2 – 8$

This could have been completed by inspection, equating co-efficients, completion of the square or by considering translations of the graph with equation $y = 2x^2$. The minimum function of a graphics calculator readily presents a useful check on the answer. It was disturbing to find students displaying a, b or c as variables involving x such as, $2(x^2 +3x) + 10$, or $2x(x + \sqrt{6x})^2 + 10$ as well as expressions such as $2(x + 3)^2 – 4$. Of those who chose to complete the square, the use of the common factor of 2 caused problems for some.

b. (0.55/1)

Correct response: (-3, -8)

Not well done. In order to obtain the mark, students were required to obtain their answer using the expression derived in a. That is, the ‘hence’ instruction had to be followed. A significant number ignored their expression in a. and used calculus or their calculator to obtain (-3, -8). This could not be accepted since it did not demonstrate the required skill.

Question 3 (1.16/3)

Correct response: $x = \frac{11\pi}{60}$

Finding $\frac{5\pi}{4}$ as the starting value was the major difficulty. Some used $-\frac{\pi}{4}$ as their starting value. The most straightforward approach was to apply relevant transformations to the starting value. Some students wasted time by considering multiple arguments, even when it ought to have been clear that some would not give the required smallest positive value.

Very few students attempted to work in degree measure, indicating that comments made in earlier reports had been heeded. The instruction ‘Where an exact answer is required to a question, appropriate working must be shown’ was ignored by a small number and a penalty incurred. Some students had difficulty manipulating fractions.

Question 4

a. (0.37/1)

Correct response: $f(x) = -\frac{1}{x + 1} + 1$

There was some confusion between the concepts of constant and variable by some students who wrote, for example $A = x$ and $B = 0$. Others had difficulty with the algebra.

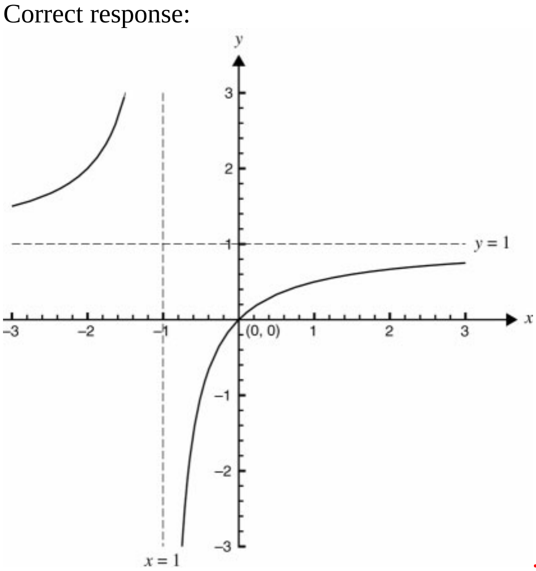
b. (0.45/1)

Correct response:R\{-1} **or** (-∞, -1) ∪ (-1, ∞) **or** {x: $x \neq -1$}

There was quite a wide variation in the use of notation here, some correct and others clearly incorrect. Some students thought that D was a number rather than a set. Incorrect responses included –1, [-∞, -1] ∪ [-1, ∞], D\-1, X\-1. Students should be familiar with the relevant mathematical conventions and notations for expressing domains.

c. (0.94/2)

Correct response:



A substantial number of students submitted a graph that was completely and correctly labelled, showing correct asymptotic behaviour. It would appear that teachers had taken care to provide students with critical feedback on their graphs during the year. Students had to **label** the asymptotes with their equations and **write down** the coordinates of the point of intersection with the axes, for example (0, 0). Those who wrote the required information separate from the graph and not showing any connection with it, usually at the side of the page, did not obtain credit since it was not clear which part of the information was associated with which part of the graph. Some who failed to obtain marks in a. and b. managed to draw a correct graph. Some of those who obtained the graph from their calculator failed to recognise that asymptotes had to be included.

Non-asymptotic behaviour was displayed by some graphs, that is, when graphs did not approach asymptotes as they should but moved closer then 'curled away'. Even more disturbing were various diagrams that suggested that the graph was not that of a one-to-one function. Some students checked the shape of their graph with that produced by their graphics calculator, but did not correctly enter the equation into the graphics calculator. A few were unable to identify the correct type of graph required and drew straight lines or parabolas.

Those students who correctly sketched a graph based on an incorrect division in a. were potentially able to obtain both marks for their graph.

Question 5

a. (0.91/2)

Correct response: $\frac{dV}{dt} = -(t+5)$

so $-(t + 5) = -10$

gives $t = 5$

Quite well done. However, it was common to see students who had not read the question carefully enough and had used $V'(-10)$ which happened to produce the correct answer of 5. Others incorrectly used $V(-10)$. Occasionally, the negative sign before 10 was ignored.

b. (0.95/2)

Correct response: Average rate of change of V with respect to t over [0, 2]

$$= \frac{V(2) - V(0)}{2}$$

$$= \frac{\left(-\frac{49}{2} + 2000\right) - \left(\frac{-25}{2} + 2000\right)}{2}$$

$$= -6$$

Quite well done. While many students worked correctly, there were many expressions dragged up to attempt to obtain the answer. Some students realised, correctly, that the 2000 could be safely left out of the calculations. Some of the incorrect expressions used were $\frac{V(2) + V(0)}{2}$, $\frac{V'(2) - V'(0)}{2}$ and even $\frac{V'(0) + V'(1) + V'(2)}{2}$, while others thought that it was permissible to differentiate.

For this question it was expected that students would typically use a graphics calculator to obtain the three answers although for part a, $x = 1$ could be identified from the rule for "f".

a. (0.63/1)

Correct response: 1.

Quite well done. Some complicated approaches were used including trying to solve $2^{x-1} = 0$ and finding $f(0)$. Some gave the answer as coordinates (1, 0).

b. (0.47/1)

Correct response: -0.531.

Reasonably well done, but coordinates were given by some, e.g. (-0.443, -0.531). Those who attempted to use calculus usually did not get very far.

c. (0.36/1)

Correct response: 0.153.

Not well done. Those who attempted to use calculus generally came to grief and others tried to find $\{x: f'(x) = 0\}$.

Question 7 (1.25/3)

Correct response: $\int_2^a \frac{1}{2(x-1)}dx = \frac{1}{2}\left[\log_e(x-1)\right]_2^a$

$\Rightarrow \frac{1}{2}\left[\log_e(x-1)\right]_2^a = 1$

$\frac{1}{2}\left(\log_e(a-1) - \log_e(2-1)\right) = 1$

$\log_e(a-1) = 2$

$a = e^2 + 1$

Nearly 30% of students achieved full marks on this question and many of the solutions were well presented although setting out, and care with notation, could have been better. Incorrect antiderivatives included $\log_e(x-1)$ and $\frac{1}{2}\log_e(2x-1)$ as well as multiples of $(x-1)^{-2}$.

It was rather worrying to see students who believed that $2(x-1) = 2x - 1$. Substitution of the terminals was usually done well and credit was given for correct substitution into an incorrect logarithmic expression from part a. Most of those who worked through correctly gave the exact answer.