2008 HSC Notes from the Marking Centre Mathematics

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MATHEMATICS

Introduction

This document has been produced for the teachers and candidates of the Stage 6 course in Mathematics. It contains comments on candidate responses to the 2008 Higher School Certificate examination, indicating the quality of the responses and highlighting their relative strengths and weaknesses.

This document should be read along with the relevant syllabus, the 2008 Higher School Certificate examination, the marking guidelines and other support documents which have been developed by the Board of Studies to assist in the teaching and learning of Mathematics.

Candidates are advised to read the questions carefully and set out their working clearly. In answering parts of questions, candidates should state the relevant formulas and the information they use to substitute into the formulas. In general, candidates who show working make fewer mistakes. When mistakes are made, marks can be awarded for the working shown. If a question part is worth more than one mark, working is expected to be shown. Any rough working should be included in the answer booklet for the question to which it applies.

Question 1

(a) Many candidates used the calculator incorrectly. The main error was to use degree mode in the calculation arriving at the incorrect answer of 1.999879… .
In weaker responses, candidates did not convert their answers to three significant figures and instead gave answers to three decimal places.

(b) Responses included a variety of methods to factorise the given expression. Most successful responses used the cross method and many candidates were able to do it by inspection. However, many candidates solved the expression as an equation with the right hand side equal to zero and gave the answer as roots of that equation. Some of these responses then presented the correct factors as required.

(c) In weaker responses, incorrect denominators were used. Often the numerator was calculated correctly but without a denominator given in the answer. Erroneous cancelling of terms also led to incorrect solutions. Poor setting out of working in many responses seemed to contribute to errors in this part.

(d) In weaker responses, candidates displayed some understanding of absolute value but set up their equations incorrectly. Incorrectly solving the equations was the most common error. Some candidates did not recognise that there were two cases to consider. In the better responses, candidates found the solutions to both cases and then went on to test their answers to confirm that they had the correct solution.

(e) In weaker responses, candidates expanded the expression correctly but were unsuccessful in simplifying the result. Errors were made in the addition and subtraction of like terms. Many did not simplify fully, giving the answer as $6 + 3\sqrt{3} - 5$ instead of $1 + 3\sqrt{3}$.

(f) In weaker responses, candidates found the common difference but did not complete this part as they used an incorrect sum formula or incorrectly substituted into their correct formula. Some responses found the 21st term of the series instead of the sum of 21 terms. A number of candidates got the correct answer by adding all 21 terms on their calculator at a considerable cost in time.

Question 2

Better responses to this question were well set out, showing all of the steps, including substitutions, in a clear and logical sequence.

Candidates are urged to improve their algebraic skills to avoid common errors such as the following

$$\frac{(x+4)\cos x - \sin x}{(x+4)^2} = \frac{\cos x - \sin x}{x+4}.$$

(a) (i) Better responses to this part used setting out such as

$$f'(x) = 9(x^2+3)^8 \times 2x$$
$$= 18x(x^2+3)^8$$

that clearly demonstrated understanding of the chain rule. Common incorrect responses included $f'(x) = 9(x^2+3)$, $9(x^2+3) \times 2x$ or $9(x^2+3)^8 \times 2$.

(ii) In better responses to this part, candidates either wrote down the product rule and explicitly identified the components or used setting out that mirrored the formula. The most common errors in this part were thinking that the derivative of $\log(x)$ is $\log(x)$ and not recognising that the product rule was needed.

(iii) The most successful approach to this part was to use the quotient rule rather than rewriting $\frac{1}{x+4}$ as $(x+4)^{-1}$ and using the product rule. As with the previous part, in better responses, candidates either wrote down the quotient rule and explicitly identified the components or used setting out that mirrored the formula. The most common errors in this part were thinking that the derivative of $\sin x$ is $-\cos x$, incorrectly stating the quotient rule, for example, using a plus sign in the numerator instead of a minus sign and incorrectly substituting into the correct formula.

(b) In better responses, candidates wrote down the correct formulae and then substituted into these. The most common errors were not knowing how to calculate the midpoint, finding the equation of the line with the given gradient but passing through an endpoint rather than the midpoint and finding the equation of the line passing through the two endpoints.

(c) Candidates are reminded that a table of standard integrals is provided at the end of the examination paper.

(i) In better responses, candidates recognised that the primitive involved a logarithm.

(ii) In better responses, candidates set this question out in three steps: finding the primitive, substitution of the limits and then evaluation of the resulting expressions. Candidates are reminded that all steps in a solution need to be shown. Common errors were finding an incorrect primitive, for example $3\tan(3x)$, $\frac{1}{3}\tan(x)$ or $\tan\left(\frac{3x^2}{2}\right)$, using $\frac{\pi}{2}$ as the upper limit instead of $\frac{\pi}{12}$ and using degrees instead of radians.

Question 3

(a) (i) In better responses, candidates successfully found the gradients of each line. Some candidates did not state a conclusion.

(ii) In better responses, candidates successfully found the coordinates of D. Incorrect solution of the equation $2x - 5 - 1 = 0$ was the most common error.

(iii) Most candidates were successful in this part.

(iv) The perpendicular distance formula was not known by a significant number of candidates. In the better responses, candidates quoted the perpendicular distance formula, showed the line of substitution without any calculation and then simplified.

(v) Successful candidates mostly used the area formula for a trapezium after finding the length AD. Others divided the area into various shapes, with the better responses providing a diagram that clearly identified those shapes.

(b) (i) Better responses demonstrated an understanding that the chain rule rather than the product rule was required and that the derivative of $\cos x$ is $-\sin x$.

(ii) In better responses, candidates recognised the connection between parts (i) and (ii) and correctly placed the negative sign. Candidates are reminded that it is important to show the first line of substitution into the primitive function.

Question 4

(a) In the better responses, candidates presented a copy of the diagram as requested and a planned solution via annotations on their diagram prior to attempting a written response. Use of the given set of parallel lines and recognition of the correct pair of equal alternate angles led to the most succinct responses. Candidates are advised against writing an extensive list of geometric facts pertinent to the diagram as opposed to focusing on answering the given question. Some responses listed angles QXR and XRY incorrectly as alternate and therefore equal angles, in conflict with the correct solution. Candidates should also take note that a diagram with more than one triangle does not necessarily imply the intention of a proof involving similarity or congruence. Correct naming of an angle is essential when more than one angle share a common vertex, writing angle XRQ rather than just angle R.

(b) Most candidates recognised the series as geometric.

(i) The most common error was the inclusion of the original height as part of the zoom sequence, that is, using the n^{th} term of a geometric progression with $a = 50$ and $n = 8$.

(ii) The link between parts (b)(i) and (b)(ii) was recognised in most responses. Clear setting out was an advantage and most candidates demonstrated good knowledge of the logarithm laws when solving their exponential equation. Many responses that listed the terms of the sequence were successful. A common error was to assume the solution involved the sum of a geometric progression. A large number of responses contained working that did not lead to the answer.

(c) Candidates who used the equation as given generally answered the question well. Those who rewrote the equation with y as the subject or used calculus tended to find the initial parts difficult.

(i) In weaker responses, candidates found an incorrect answer by a calculation using the y-intercept.

(ii) In better responses, candidates were successful in finding the focal length from the given equation. Candidates are reminded to read the question carefully as many only found the focal length rather than the required coordinates of the focus.

(iii) A significant number of candidates used the incorrect results obtained in parts (i) and (ii) to successfully display an appropriate sketch. However some candidates failed to realise the conflict in their representation. Candidates are reminded to label their axes when drawing a sketch and to indicate a scale.

(iv) Most candidates were aware that the solution involved integration. The most concise and successful approach involved finding the area with respect to the x-axis and using the symmetry of the function. Common errors included the use of incorrect limits, the interpretation of the question as the volume of a solid of revolution, incorrect algebra and forgetting to use subtraction of areas when working with respect to the x-axis. Candidates choosing to evaluate their area with respect to the y-axis encountered a more difficult integral and made more algebraic errors when attempting to evaluate.

Question 5

(a) In this part, responses displayed considerable confusion regarding the meaning and use of the derivative and the distinction between curves and their tangents. A very common error was to treat the gradient function $\frac{dy}{dx}$ as if it were a fixed gradient and to then attempt to find the equation of the tangent via $(y - 7) = (1 - 6\sin(3x))(x - 0)$. It was also quite common to incorrectly argue that $m = y'(0) = 1$ and hence that $(y - 7) = (1)(x - 0)$. Better responses calculated appropriate primitives and correctly evaluated the arbitrary constant of integration. Candidates are encouraged to make full use of the table of standard integrals.

(b) (i) Although many candidates correctly recognised that the geometric series had a common ratio of $r = 2x$, many did not then proceed to argue that the limiting sum only existed when $|r| < 1$. Responses which reached $|2x| < 1$ often then failed to solve the absolute value inequality correctly, with common errors being to conclude that $x < \frac{1}{2}$, $x < \pm\frac{1}{2}$ or even $x < \left|\frac{1}{2}\right|$. Candidates should be aware that $\leq$ and $<$ are not interchangeable symbols and that in the context of this part all inequalities needed to be strict.

(ii) In better responses, candidates correctly implemented the formula $S_\infty = \frac{a}{1-r} = \frac{5}{1-2x} = 100$.

(c) (ii) Candidates should be aware that the natural logarithm function $\log_e(x)$ appears as ln on most calculator keypads and not as log (which is log to base 10). Responses that presented a clear final answer in parts (ii) and (iii) in terms of natural logs and exponentials were not penalised for incorrect subsequent evaluations using the calculator.

(iii) In some better responses, candidates answered part (iii) efficiently by arguing that $I' = kI = 1000k$. An alternative for this part was to differentiate the formula for intensity with respect to distance s and then make appropriate substitutions for A, k and s. Common errors were to differentiate with respect to k rather than s, to argue that $\frac{d}{ds}e^{-ks} = -kse^{-ks-1}$ or to abandon the use of calculus altogether and calculate the average rate of change in intensity over 6 metres rather than the instantaneous rate at $s = 6$.

Question 6

Poor algebra, especially in parts (a) and (c), frequently prevented some candidates achieving full marks. Also there were a number of responses that included multiple attempts without crossing out their inferior choices thereby sometimes missing out on marks.

(a) Many candidates had problems with the algebraic solution. The domain caused a number of problems with many candidates failing to restrict their solutions or obtaining the negative value. A number of answers were given in degrees. Some used double angle formulae successfully, although this was not easier or quicker than the standard approach. Candidates who tried to graph the sine function rarely achieved any marks.

(b) (ii) and (iii)
In better responses, candidates interpreted the velocity graph and the language of motion. In some weaker responses, candidates did not distinguish between $v = 0$ and $a = 0$ and consequently made errors in parts (ii) and (iii).

(iv) A range of techniques were used with the most successful being

$$\text{Area} \approx \frac{h}{3}\{y_0 + y_n + 4(\text{odds}) + 2(\text{evens})\}.$$

Candidates that used this approach made fewer mistakes and demonstrated the most efficient working, although some swapped the odds and evens in the above equation. Using a table was also a very successful technique but involved a little more setting out. The least successful method was repeated application of $\text{Area} \approx \frac{b-a}{6}\left\{f(a) + 4f\left(\frac{a+b}{2}\right) + f(b)\right\}$ as candidates often used y values for a and b and often did not find function values. Mistakes included using the wrong number of function values, using x values in place of y and inappropriate use of the brackets in the formula. Some candidates used the Trapezoidal Rule instead.

(c) In this part, mid-range responses demonstrated that they understood the method for finding the volume of a solid of revolution but many subsequently had difficulty in finding a primitive of $\frac{25}{(x-2)^2}$. There were many algebraic mistakes such as assuming that $\frac{25}{x^2 - 4x + 4} = \frac{25}{x^2} - \frac{25}{4x} + \frac{25}{4}$. Some candidates did not find the square of y and hence changed it into a logarithmic integral or were overly keen to use logs simply because the function had a fraction.

Question 7

(a) In many responses candidates did not recognise that the expression was equivalent to a quadratic equation. Quality responses replaced $\log_e x$ with a variable such as u. A significant number of responses indicated that there was no solution to $\log_e x = -1$ or could not determine $x = e^3$ or $x = e^{-1}$ from $\log_e x = 3$ or $\log_e x = -1$.

(b) (i) Most candidates used the formula $l = r\theta$ and stated $l = \frac{10\pi}{3}$. The better responses used $\theta \le 2\pi$ or $\frac{10\pi}{3} \le 2\pi r$ to show $r \ge \frac{5}{3}$.

(ii) Typical responses applied the formula $A = \frac{1}{2}r^2\theta$ and substituted $r = 4$. Quality responses calculated $\theta = \frac{5\pi}{6}$ and correctly evaluated the area of the sector.

(c) (i) A common error occurred when candidates did not read this part carefully and presented a tree diagram with eight outcomes. Outcomes that cannot occur should not be drawn.

(ii) Typical responses applied the laws of probability and made some progress. The better responses stated the correct outcomes and their probabilities. Candidates are encouraged to show all working.

(iii) There were many different methods of answering this part. Responses that identified an appropriate complementary event were awarded a mark. A significant number of responses contained simple calculation errors. Candidates are reminded to state the outcomes and their probabilities.

Question 8

(a) (i) To find the x intercepts, candidates were ultimately required to solve $x^2(x^2 - 8) = 0$. Common errors included ignoring $x = 0$ or $x = \sqrt{8}$.

(ii) Better responses stated the condition for an even function, namely $f(-x) = f(x)$, and demonstrated this by successful substitution and simplification. Candidates are reminded that showing the result is true for particular integer values of x is not a proof.

(iii) Candidates were required to find all three stationary points and determine their nature. Many errors were made in solving the equation obtained by setting the derivative, $4x^3 - 16x$, equal to 0. The tests used to determine the nature of the stationary points should be clearly labelled and a conclusion explicitly drawn. Candidates who used the second derivative were generally more successful.

Only a few responses used the result of part (ii) to argue that, having found a minimum turning point at $x = 2$, another minimum must occur at $x = -2$. Candidates are also reminded that it is a waste of valuable time to find points of inflection when the question does not require it.

(iv) Candidates should be aware that the graphs of quartic functions are continuous and smooth, and that even functions are symmetric about the y -axis. Sensible scales should be used and shown on the axes and the stationary points and intercepts should be clearly indicated. If contradictions arise then an error must have occurred and candidates may need to go back over their working if they are to succeed in completing their sketch.

(b) The instruction to copy the diagram is designed to facilitate the use of the diagram in candidates' responses. For that reason it should be placed on the same page as the response. Candidates need to take care naming angles and triangles, and also to provide justification for every step of their reasoning. The claim that some fact is given should only be used when that fact is clearly stated as such in the data provided, and not when it has been deduced from the data. The mark value of a question is a good indication of the likely complexity of the required solution.

(i) In better responses, candidates equated both line segments to AB with appropriate reasons. Some responses first proved that triangles ABD and DCB are congruent, in order to then prove $AB = CD$ at a considerable cost in time compared to a simpler solution.

(ii) Many candidates had difficulty proving the included angles, EBH and BCD (or BAD), are equal, often falsely claiming angles were vertically opposite when they were not. The symbols for congruence and similarity were often confused. Better responses were clear, logical and concise, and many effectively used single characters as names for angles.

Question 9

(a) (i) In better responses, candidates recognised that the complement of 85% was required in this part and many then went on to successfully find the correct numerical expression. A common error was in the use of the complement, for example, $1 - 0.85^2$. A significant number of candidates could not calculate the final answer, especially when fractions were involved. Responses containing a tree diagram almost always gained at least one mark.

(ii) Many candidates were able to find the correct answer, however a significant number then continued to do a further calculation, most commonly 0.17×0.85, indicating that they had misunderstood the question.

(b) (i) The most successful candidates were those that developed the correct expression, starting from the given expression for A_1, then finding A_2, A_3 and on to A_n. Candidates are reminded that working needs to be shown, as incorrect expressions for A_n without supporting working could not be awarded marks that were available for intermediate steps. Apart from those responses where candidates could not successfully develop the correct expression for A_n, another common error was in calculating the interest rate to be used, despite the fact that the expression for A_1 was given.

(ii) Candidates who developed the correct expression for A_n were generally successful in this part. In better responses, candidates recognised and were able to sum a geometric series and few calculator errors were evident. Common mistakes were in using $n = 143$ in the sum of the geometric series, substituting $n = 12$ into the expression for A_n and incorrect manipulation of the equation in M.

(c) (i) In better responses, candidates recognised that integration was required to find the given result. Few candidates were awarded full marks due to the absence of the constant of integration in their solution or failing to clearly find the value of that constant. A common mistake was attempting to integrate b^2 as if it was a variable. The constant of integration could be evaluated by stating that a stationary point occurred at $x = 0$ or by noting that $f'(x)$ was an odd function, although that approach was not common. Responses that attempted to evaluate the constant by considering $f'(-b)$ and $-f'(b)$ were less successful. A small number of responses attempted to complete this question by differentiation of the given result, with limited success.

(ii) Better responses found a primitive with a constant of integration that could be evaluated by considering the point $(b, 0)$, the most common error being in the integral of $\frac{x^3}{3}$. A significant number of responses attempted to set $f'(x) = 0$, without integrating. This approach did not lead to the correct solution.

Question 10

Candidates are reminded to attempt all questions of the paper and not to assume that marks cannot be gained in Question 10. Many candidates gained some marks in this question by correctly starting one or more of the parts.

(a) Many responses contained an initial line of working which could lead to the correct solution and so gained a mark. In most of the successful responses, candidates correctly made x the subject of the equation, although some were careless with their operations. The most successful technique was to find the area between the lines $x = 7$ and $x = e^y + 2$ with respect to the y-axis between the limits $y = 0$ and $y = \log_e 5$. Some attempted to subtract the area with respect to the y-axis from the area of the rectangle but did not complete this successfully, either not attempting the subtraction or not completing it correctly. Some candidates obtained the correct solution using a substitution or, on rare occasions, integration by parts. Candidates are reminded to refer to their standard integral table, as this may have prevented some candidates from attempting to integrate $\log_e(x-2)$ with respect to the x-axis directly.

(b) (i) Many candidates correctly found an expression for the area of triangle OKJ. Most found it much more difficult to find an expression for the area of triangle OMP as they were not able to use similar triangles to find an expression for the length of side MP. A number of responses that provided a correct expression for the area of each triangle did not simplify the sum of these areas to reach a given expression. This was mostly due to errors involving algebraic manipulation.

(ii) Candidates are reminded that they did not need to find the given expression in the first part in order to use it successfully in this part. Many candidates who could not complete part (i) were able to gain marks in this part by successfully differentiating the expression, although a significant number did not treat l, and α as constants in this expression. Again algebraic errors caused problems. Many who attempted this part did endeavour to find the values of x for which their derivative was equal to zero, and then use either the first or second derivative to justify that their x value would give a minimum value of A. Many responses would have earned additional marks if evidence of working had been provided.

(iii) For those few better responses that had correct expression for MP and the correct value of x, this final substitution and simplification were usually well done.

Mathematics

2008 HSC Examination Mapping Grid

Question	Marks	Content	Syllabus outcomes
1 (a)	2	1.1, 12.4	P3, H3
1 (b)	2	1.3	P3
1 (c)	2	1.3	P3
1 (d)	2	1.2, 1.4	P3
1 (e)	2	1.1	P3
1 (f)	2	7.1	H5
2 (a) (i)	2	8.8, 8.9	P7
2 (a) (ii)	2	8.8, 12.4	H5
2 (a) (iii)	2	8.8, 13.5	H5
2 (b)	2	6.2, 6.7	P4
2 (c) (i)	1	11.2, 11.2, 12.5	H5
2 (c) (ii)	3	11.1, 11.2, 13.6	H5
3 (a) (i)	2	2.3, 6.2	P2, P3, P4
3 (a) (ii)	1	6.8	H5
3 (a) (iii)	1	6.5	P3, P4
3 (a) (iv)	2	6.5	P3, P4
3 (a) (v)	2	6.8	H5
3 (b) (i)	2	8.9, 12.4, 13.5	H5
3 (b) (ii)	2	11.2, 13.7	H5
4 (a)	2	2.5	H2
4 (b) (i)	2	7.5	H3, H4, H5
4 (b) (ii)	2	7.5, 12.2	H3, H4, H5
4 (c) (i)	1	9.5	P3
4 (c) (ii)	1	9.5	P3
4 (c) (iii)	1	9.5	P3
4 (c) (iv)	3	11.4	H5, H8
5 (a)	3	11.2, 12.5	H3, H5
5 (b) (i)	2	7.3	H5
5 (b) (ii)	2	7.3	H5
5 (c) (i)	1	14.2	H3, H4, H5
5 (c) (ii)	2	14.2	H3, H4, H5
5 (c) (iii)	2	14.2	H3, H4, H5
6 (a)	3	13.1, 5.2	H5

Question	Marks	Content	Syllabus outcomes
6 (b) (i)	1	14.3	H4, H5, H7
6 (b) (ii)	1	14.3	H4, H5, H7
6 (b) (iii)	1	14.3	H4, H5, H7
6 (b) (iv)	3	11.3, 14.3	H4, H5
6 (c)	3	11.4	H8
7 (a)	3	1.3, 1.4, 12.3	H3
7 (b) (i)	2	13.1	H5
7 (b) (ii)	2	13.1	H5
7 (c) (i)	1	3.1, 3.3	H5, H9
7 (c) (ii)	2	3.2, 3.3	H5, H9
7 (c) (iii)	2	3.2, 3.3	H5, H9
8 (a) (i)	2	4.2, 10.5	P3
8 (a) (ii)	1	4.2	P4
8 (a) (iii)	4	10.2	H6
8 (a) (iv)	1	10.5	P6
8 (b) (i)	1	2.5	H2, H9
8 (b) (ii)	3	2.5	H2, H9
9 (a) (i)	2	3.2	H4, H5
9 (a) (ii)	1	3.2	H4, H5
9 (b) (i)	2	7.5	H5, H9
9 (b) (ii)	3	7.5	H5, H9
9 (c) (i)	2	11.2	H5, H7, H9
9 (c) (ii)	2	10.8, 11.2	H5, H7, H9
10 (a)	5	11.41, 12.3	H3, H8, H9
10 (b) (i)	3	2.3	H4, H5, H9
10 (b) (ii)	3	10.6	H4, H5, H6
10 (b) (iii)	1	1.1	H4, H9

BOARD OF STUDIES
NEW SOUTH WALES

2008 HSC Mathematics
Marking Guidelines

The following marking guidelines were developed by the examination committee for the 2008 HSC examination in Mathematics and were used at the marking centre in marking student responses. For each question the marking guidelines are contained in a table showing the criteria associated with each mark or mark range.

The information in the marking guidelines is further supplemented as required by the Supervisor of Marking and the senior markers at the marking centre.

A range of different organisations produce booklets of sample answers for HSC examinations, and other notes for students and teachers. The Board of Studies does not attest to the correctness or suitability of the answers, sample responses or explanations provided. Nevertheless, many students and teachers have found such publications to be useful in their preparation for the HSC examinations.

A copy of the Mapping Grid, which maps each question in the examination to course outcomes and content as detailed in the syllabus, is also included.

Question 1 (a)

Outcomes assessed: P3, H3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Correct value of $2\cos\frac{\pi}{5}$ OR • Evidence of correct rounding to 3 significant figures	1

Question 1 (b)

Outcomes assessed: P3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Solves $3x^2 + x - 2 = 0$ OR • Shows some understanding of factorisation	1

Question 1 (c)

Outcomes assessed: P3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Rewrites using a common denominator or equivalent result	1

Question 1 (d)

Outcomes assessed: P3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Shows some understanding of absolute value	1

Question 1 (e)

Outcomes assessed: P3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Writes $\left(\sqrt{3}\right)^2 = 3$ or equivalent merit	1

Question 1 (f)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Identifies the common difference	1

Question 2 (a) (i)

Outcomes assessed: P7

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Shows some knowledge of the chain rule or equivalent merit	1

Question 2 (a) (ii)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Shows some knowledge of the product rule or equivalent merit	1

Question 2 (a) (iii)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Shows some knowledge of the quotient rule or equivalent merit	1

Question 2 (b)

Outcomes assessed: P4

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Finds M	1

Question 2 (c) (i)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct primitive	1

Question 2 (c) (ii)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Attempts to substitute into correct primitive or equivalent merit	2
• Primitive of the form $A \tan x$ or equivalent merit	1

Question 3 (a) (i)

Outcomes assessed: P2, P3, P4

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Shows that one line has slope 2	1

Question 3 (a) (ii)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 3 (a) (iii)

Outcomes assessed: P3, P4

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 3 (a) (iv)

Outcomes assessed: P3, P4

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Show some understanding of the perpendicular distance formula	1

Question 3 (a) (v)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Finds the length of AD or equivalent merit	1

Question 3 (b) (i)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Shows some understanding of the chain rule	1

Question 3 (b) (ii)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Correctly applies the result from part (i)	1

Question 4 (a)

Outcomes assessed: H2

MARKING GUIDELINES

Criteria	Marks
• Correct solution. Justifications (abbreviated or otherwise) which indicate the appropriate geometric fact are acceptable	2
• Proof with insufficient justification	1

Question 4 (b) (i)

Outcomes assessed: H3, H4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Recognises the sizes are in geometric progression	1

Question 4 (b) (ii)

Outcomes assessed: H3, H4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Obtains $50 \times 1.2^n > 400$	1

Question 4 (c) (i)

Outcomes assessed: P3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 4 (c) (ii)

Outcomes assessed: P3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 4 (c) (iii)

Outcomes assessed: P3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 4 (c) (iv)

Outcomes assessed: H5, H8

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Correct primitive	2
• Correct integrand or equivalent result	1

Question 5 (a)

Outcomes assessed: H3, H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Correct primitive	2
• Candidate's curve passes through (0, 7)	1

Question 5 (b) (i)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Recognises that $\left\| r \right\| < 1$	1

Question 5 (b) (ii)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Obtains $\frac{5}{1-2x} = 100$ or equivalent result	1

Question 5 (c) (i)

Outcomes assessed: H3, H4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 5 (c) (ii)

Outcomes assessed: H3, H4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Obtains $1000 = 6000e^{-6k}$ or equivalent result	1

Question 5 (c) (iii)

Outcomes assessed: H3, H4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Computes $\frac{dI}{ds}$ correctly	1

Question 6 (a)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	3
• Obtains one correct solution	2
• Obtains $\sin\frac{x}{3} = (\pm)\frac{1}{\sqrt{2}}$ or equivalent merit	1

Question 6 (b) (i)

Outcomes assessed: H4, H5, H7

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 6 (b) (ii)

Outcomes assessed: H4, H5, H7

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 6 (b) (iii)

Outcomes assessed: H4, H5, H7

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 6 (b) (iv)

Outcomes assessed: H4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Shows a good understanding of Simpson's rule applied to the appropriate integral	2
• Shows some understanding of Simpson's rule	1

Question 6 (c)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Correct primitive	2
• Shows some understanding of how to compute volumes of revolution	1

Question 7 (a)

Outcomes assessed: H3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Obtains $\log_e x = 3$ or -1	2
• Recognises that this is equivalent to a quadratic equation	1

Question 7 (b) (i)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Shows that $r\theta = \dfrac{10\pi}{3}$ or equivalent result	1

Question 7 (b) (ii)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Demonstrates an understanding of how to compute the area of a sector	1

Question 7 (c) (i)

Outcomes assessed: H5, H9

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 7 (c) (ii)

Outcomes assessed: H5, H9

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Correct probability of one event corresponding to Gabrielle winning the series or equivalent merit	1

Question 7 (c) (iii)

Outcomes assessed: H5, H9

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Identifies the complementary events or equivalent merit	1

Question 8 (a) (i)

Outcomes assessed: P3

MARKING GUIDELINES

Criteria	Marks
• Correct answers	2
• Obtains at least one intercept or equivalent merit	1

Question 8 (a) (ii)

Outcomes assessed: P4

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 8 (a) (iii)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Correct solution	4
• Correct points and nature without correct justification	3
• Solves $f'(x) = 0$	2
• Computes $f'(x)$	1

Question 8 (a) (iv)

Outcomes assessed: P6

MARKING GUIDELINES

Criteria	Marks
• Correct sketch or sketch consistent with answers given in parts (i) and (iii)	1

Question 8 (b) (i)

Outcomes assessed: H2, H9

MARKING GUIDELINES

Criteria	Marks
• Correct solution. Justifications (abbreviated or otherwise) which indicate the appropriate geometric facts are acceptable	1

Question 8 (b) (ii)

Outcomes assessed: H2, H9

MARKING GUIDELINES

Criteria	Marks
• Correct solution. Justifications (abbreviated or otherwise) which indicate the appropriate geometric facts are acceptable	3
• Proof without sufficient justification	2
• $\angle EBH = \angle BCD$ or equivalent result	1

Question 9 (a) (i)

Outcomes assessed: H4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Recognises that $P(\text{not own}) = 0.15$	1

Question 9 (a) (ii)

Outcomes assessed: H4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 9 (b) (i)

Outcomes assessed: H5, H9

MARKING GUIDELINES

Criteria	Marks
• Obtains correct formula for A_n	2
• Makes some progress towards finding a formula for A_n	1

Question 9 (b) (ii)

Outcomes assessed: H5, H9

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Obtains $200M = \dfrac{100\,000(1.005)^{144}}{(1.005)^{144}-1}$ or equivalent result	2
• Obtains an expression for M by setting $A_{144} = 0$	1

Question 9 (c) (i)

Outcomes assessed: H5, H7, H9

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Finds a primitive of $f''(x)$	1

Question 9 (c) (ii)

Outcomes assessed: H5, H7, H9

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Finds a primitive of $f'(x)$	1

Question 10 (a)

Outcomes assessed: H3, H8, H9

MARKING GUIDELINES

Criteria	Marks
• Correct solution	5
• Obtains $A = \left[5y - e^y\right]_0^{\log_e 5}$ or equivalent merit	4
• Obtains $A = \int_0^{\log_e 5} 5 - e^y dy$ or equivalent merit	3
• Shows that $x = e^y + 2$ or equivalent merit	2
• Writes $A = \int_3^7 \log_e (x-2) dx$ OR • Attempts to make x the subject or equivalent merit	1

Question 10 (b) (i)

Outcomes assessed: H4, H5, H9

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Shows Area $OMP = \frac{1}{2x}(\ell - x)^2 \sin\alpha$	2
• Shows Area $OKJ = \frac{1}{2} xs \sin\alpha$	1

Question 10 (b) (ii)

Outcomes assessed: H4, H5, H6

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Finds stationary point at $x = \frac{\ell}{\sqrt{2}}$	2
• Computes $\frac{dA}{dx}$	1

Question 10 (b) (iii)

Outcomes assessed: H4, H9

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1