2007 HSC Notes from the Marking Centre Mathematics

Published by Board of Studies NSW
GPO Box 5300
Sydney 2001
Australia

Tel: (02) 9367 8111
Fax: (02) 9367 8484
Internet: http://www.boardofstudies.nsw.edu.au

ISBN 978 174147 8617

2007755

Contents

Question 1....4
Question 2....5
Question 3....5
Question 4....6
Question 5....6
Question 6....7
Question 7....8
Question 8....9
Question 9....10
Question 10....11

2007 HSC NOTES FROM THE MARKING CENTRE
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 2007 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 2007 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 are able to be awarded for the working shown. If a question part is worth more than 1 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) The majority of errors came from candidates calculating incorrect expressions such as $\sqrt{3.14^2+5}$, $\sqrt{\pi^2}+5$, π^2+5, $\sqrt{\pi^2\times 5}$, $\sqrt{\pi^2-5}$, $\sqrt{\pi^2 \div 5}$ or $\pi+\sqrt{5}$. Candidates should write their calculator display before rounding off.

(b) A significant number of responses did not include a correct graph of their inequality on a number line. A closed circle on the number line and a region on a number plane were common errors.

(c) Better responses applied the correct conjugate surd. However, some candidates incorrectly multiplied by $\frac{\sqrt{3}-1}{\sqrt{3}-1}$ or $\frac{\sqrt{3}}{\sqrt{3}}$.

(d) Typical responses determined the common ratio of $\frac{1}{4}$. Incorrect answers resulted from candidates using the wrong formula for the limiting sum, such as $\frac{a}{r-1}$ and $\frac{a}{1+r}$.

(e) A significant number of responses solved the corresponding quadratic equation. Weaker responses did not determine the two correct factors. Candidates are advised to always check their answer by expanding.

(f) The most common error was not correctly determining the gradient of the line $2x+y+4=0$. Some candidates did not apply the formula $m_1m_2=-1$. Simple errors were also made substituting the point (–1, 3) into the gradient–intercept formula.

Question 2

(a) (i) Common errors included reversing the terms in the numerator, the wrong sign, and claiming that the derivative of *2x* is *x* or that of e^{x+1} is $x e^{x}$. Some candidates rewrote the quotient as a product but then had very limited success applying the product rule. Candidates are reminded to use brackets where appropriate.

(ii) Common errors included omitting the indices of 9 on (1+ tan *x*) or 2 on sec *x*, and incorrectly finding the derivative of 1+ tan *x*. Candidates are reminded that the derivative of tan*x* can be obtained using the standard integral sheet.

(b) (i) Common incorrect responses for $\int \cos 3x dx$ were 3sin 3*x*, $\frac{1}{3}$ sin*x* or -$\frac{1}{3}$sin 3 *x* . Quite a few candidates lost a very easy mark by forgetting to integrate the '1' term. Once again, candidates are advised to use the standard integral sheet for trigonometric functions.

(ii) Many candidates could not correctly find the primitive of x^{-2}. The most common error was to use a log function in their primitive. Once a primitive was found, candidates were usually able to apply the limits in the correct order to their primitive. Candidates are reminded that it is essential to show the substitution of the limits and use appropriate brackets before evaluating.

(c) This question required students to find the derivative of *x*sin *x*, substitute $x = \pi$ to get a gradient and then write the equation of the tangent at (π ,0). Common errors included not recognising *x*sin *x* as a product, incorrect signs in the derivative, failing to substitute into the derivative, and incorrectly evaluating the gradient. Many responses used degree mode on the calculator for the evaluation, while others mistakenly seemed to think that π = 180. Candidates need to clearly understand the difference between a gradient function and the gradient at a point, and should also realise that they must work in radians when applying calculus to trigonometric functions.

Question 3

(a) Typical responses answered (i) and (ii) correctly, with occasional errors stemming from the use of incorrect formulas, particularly errors in sign.

(iii) The most common line of attack was to argue in terms of properties of gradients $(m_1 m_2 = -1)$, however geometric constructions and approaches involving the judicious use of Pythagoras's theorem were also accepted.

(iv) Responses exhibited a lack of precision when explaining why *OABC* is a rhombus. Some candidates confused the term *dissect* with bisect. It is inappropriate in this context to refer to unnamed diagonals simply as *lines*.

(v) Weaker responses omitted this part completely, presumably a result of not being able to recall the formula for the area of a rhombus. It was certainly acceptable however to consider instead the areas of the various minor triangles on display. Many responses achieved a correct area with this elementary approach.

(b) (i) In this part it was required that candidates progress to a formula for the distance in terms of the one variable n only.

(ii) and (iii) It was acceptable to use enumeration methods. However, better responses made efficient use of the theory of arithmetic progressions.

(iv) Responses showing difficulty factorising the quadratic in this part often completed the question through the careful use of the quadratic formula.

Question 4

(a) Common mistakes included not answering in radians or errors involved in converting from degrees to radians.

(b) (i) The responses that included a sample space enjoyed a higher rate of success than those that tried to write an algorithm. Common errors were counting (5, 5) twice and finding the product. Some candidates did not understand the word ‘dice’.

(ii) Most responses demonstrated an understanding of the complement.

(c) (i) This caused problems because weaker responses were fixated on finding the angle, often using the cosine rule. There were many poor attempts at a mathematically correct Pythagoras proof with problems using surds. In the poorer responses, candidates had difficulty applying Pythagoras’s theorem and in using surds.

(iii) Weaker responses omitted this part.

(iv) Many candidates did not find the major sector but then they often found it correctly in part (v). Both the names and formulas for parts of the circle seemed to be interchangeable and some invented their own terms such as ‘slither’.

(v) Many candidates did not realise that the earlier parts were leading to this final answer. Concept of logo or ‘shaded’ area was lost on many candidates. Those responses that included a diagram showing the parts that needed to be found enjoyed a high level of success.

Question 5

Responses that achieved the best results typically employed the following techniques:

- All parts of the question were attempted. It should be noted that nearly all candidates who attempted the geometry part of the paper achieved some marks.
- The diagram was copied into the answer booklet and then used by adding more information. Many did not copy the diagram and many others that did copy the diagram added no information.
- Explanations for working were given, especially in part (a).

(a) (i) Better responses either found that the internal angle sum was 540° and then divided by 5, (this was the most successful method), or found that each exterior angle was 72° then took this away from 180°.

(ii) and (iii) Supplying reasons was the important factor in gaining full marks. Marks were also able to be awarded to responses where the written work was made clear by information added to a diagram in the answer booklet. Marks could not be awarded to responses that were not clear and where information may have been added to the diagram on the question paper. An example of this was when an 'x' appeared in the response, but the angle to which it referred was not identified. Full marks could not be awarded where responses did not give reasons, eg writing that AE || FD needed to be supported with the reasons why this is true.

(b) Responses which showed full working and the substitution step achieved best results. These responses minimised errors and when mistakes were made, marks were still able to be awarded.

(i) Candidates were awarded the mark for showing they understood how to find the initial velocity by substituting t = 0 into the velocity function.

(ii) The quotient formula was generally very well known and was the most successful way of finding the derivative (rather than the product rule). Candidates were expected to show that they knew the acceleration was found by finding the derivative of the velocity function.

(iii) To find when the acceleration was zero it was necessary to solve an equation involving an algebraic fraction. Better responses solved the equation resulting from equating the numerator to zero.

(iv) Marks were awarded if the primitive was found to be $\ln(16 + t^2) + C$, then the initial conditions used to find C = –ln16 and hence the displacement at t = 4. It was a common mistake to use the initial conditions and then ignore working, to state C = 0.

Question 6

(a) Better responses solved by making a substitution for e^x, with some causing themselves problems by letting $x = e^x$, leading to solutions of $x = 0$ or ½. The majority of those who found that $e^x = ½$ got to the correct 'ln' expression for x. However, a few who gave decimal approximations only failed to take into account the difference between the 'ln' and 'log' buttons on their calculator. Some of those who used the factorisation method had difficulties with selecting the correct HCF to take out, eg $e^x(e^2 – 1)$. The best responses applied 'log laws' right from the start, with their solution written as:

$$\begin{aligned} 2e^{2x} &= e^x \\ \ln(2e^{2x}) &= \ln(e^x) \\ \ln 2 + 2x &= x \\ x &= -\ln 2 \end{aligned}$$

(b) (i) A significant percentage of candidates failed to note the difference between finding 'coordinates' and determining x and y coordinates, choosing simply to solve with the substitution of $y = 0$ and/or $x = 0$. Also, candidates are advised to show at least a simple step of working regardless of the answers being 'obvious'. For example, $y = x^4 – 4x^3 = x^3(x – 4)$. Therefore the intercepts are obviously (0, 0) and (4, 0).

(ii) Candidates should be reminded of the fact that horizontal inflexion points are also stationary points, as many appeared to omit the (0, 0) stationary point from their discussion once they had determined that it was neither a maximum nor a minimum, leaving it to part (iii). Where tables were used it was often left to the marker to determine what the values represented, with no *y*, *y*' or *y*'' being indicated. A common error was the use of 'gradient' sketches under a table for the second derivative, leading to the incorrect conclusion that there was a maximum turning point at (0, 0).

(iii) Candidates are advised to check their working where a conflict arises in their solution. Many who had indicated (0, 0) as a maximum turning point in part (ii), now said that it was an inflexion in part (iii). A significant number of candidates divided by *x* and hence lost $x = 0$ as a possible solution. Second derivative errors were also common throughout, eg $y' = 4x^3 - 12x^2$, followed by $y' = 12x^2 - 12x$.

(iv) Candidates are advised to practise sketching different curves given different circumstances. Most responses failed to show the concept of a horizontal, let alone an oblique inflexion. Smooth curves were few and far between with lots of 'feathering'. Labelling and scale on axes were almost non-existent.

Question 7

(a) (i) The correct focal length was often obtained but then used with an incorrect vertex and either added or subtracted from the *y* value. Candidates who used the formula $(x-h)^2 = 4a(y-k)$ were able to make good progress with the question.

(ii) This mark was easily obtained by indicating use of simultaneous equations. Some candidates went on trying to solve the quadratic for *x*, which was not required.

(iii) Most candidates were familiar with the discriminant, ie $\Delta = b^2 - 4ac$. However, a significant number of candidates were not aware that for one root, $\Delta = 0$. Other common errors were incorrect formula, incorrect substitution into formula and inability to solve the equation that arises from substitution.

(iv) The value of *k* obtained in the previous part affected the success of candidates in this part. Some candidates were able to make progress towards solving the quadratic but were faced with no solution or two solutions. Better responses multiplied through the quadratic expression by 4 so that it did not involve fractions and then were able to factorise to $(2x-1)^2$.

(v) There were many occasions where this part indicated to candidates that the focus and *P* needed to have the same *y* value.

(b) (i) Better responses recognised that the equation reduced to $\tan x = \sqrt{3}$. Some candidates squared both sides and moved to expressions such as $\cos^2 x = \frac{1}{4}$ and $\cos x = \frac{1}{2}$. This squaring introduced extraneous roots and gave a solution in an incorrect quadrant. Some candidates successfully used the $R\cos(x+\alpha)$ form to solve the equation.

(ii) Most successful responses went directly to the area by using a single integral $\int \sin x - \sqrt{3}\cos x dx$ and proceeded from there. Most candidates were able to find the correct primitives. Incorrect answers from part (i) still allowed a sensible calculation for this part. Exact values were well handled by most candidates. When candidates reversed the functions in the integrand they sometimes failed to take the absolute value of the answer or did not realise that they were finding an area in square units. Those who chose to split the area into multiple regions generally had trouble obtaining full marks. Their regions often overlapped and the number of places where errors could occur increased.

Question 8

(a) (i) This part of the question required the candidate to substitute the given information into the equation $N = Ae^{kt}$ to produce two equations. These equations then had to be solved simultaneously to find the values for k and A. Dividing the two equations to eliminate A seemed to be the most successful approach. Further, candidates who wrote their value of k in decimal form rather than exact form had less trouble in using that value to subsequently find A.

Common problems in this part included:

- Just picking a value for A, for example $A = 1600$, or $A = 600$.
- Attempting to eliminate A by subtracting the two equations, for example $2600 - 1600 = Ae^{2k} - Ae^{k} = e^{k}$.
- Careless setting out so that $\ln\frac{1600}{A}$ became $\frac{\ln 1600}{A}$.
- Using base 10 logarithms instead of natural logarithms.

(ii) The most common errors in this part were using wrong units (eg putting N = 4 000 000 000 but leaving A as 935), mishandling the exponential term by letting $e^{\ln\left(\frac{13}{8}\right)t} = \frac{13t}{8}$, and not being able to interpret the value of t (eg interpreting $t = 2.887$ as corresponding to the year 2010 but in the month of August).

(b) In this part, candidates were instructed to copy the diagram into their writing booklet. Candidates who did not do this were more prone to making errors in naming the angles and triangles to which they were referring. Candidates could even consider copying the diagram to the back of a page so that it is visible while doing all parts of the question.

(i) Common errors included:

- Not recognising that the symbol ||| means 'is similar to'. Many candidates interpreted the symbol as 'is congruent to' and tried to prove the triangles congruent.
- Not accompanying each step in the proof with an associated justification.
- Not being careful in identifying the angles, or triangles, to which they were referring. For example, writing $\angle BBC$ instead of $\angle DBC$.
- Introducing pronumerals without stating what they referred to.

(ii) The proof required in this part involved more steps than that in part (i). While there were many ways in which to proceed in this part, better responses used the result from part (i). In addition to the errors that were common in the previous part, in this part an additional common error was to jump two or three steps in the proof while only giving a justification for one of those steps. For example, saying that $\angle EBD = \angle BDC$ as these are alternate angles on the parallel lines *BE* and *CD* but not proving that the lines *BE* and *CD* are indeed parallel.

(iii) The proof required in this part of the question entailed three basic steps: determining the ratios of which sides of the similar triangles were equal, determining the ratio of which terms in the geometric progression were equal and then linking these two sets together.

Common errors included:

- Only referring to one of the pairs of similar triangles and hence only proving that three of the terms (and not four) belonged to a geometric progression.
- Not referring to the similar triangles at all and just finding values of p and q that made the four terms a geometric progression (ie answering part (iv)).

(iv) The most successful approach to this part was to use the formula for the general term of a geometric progression and hence equate $a = 8$ and $ar^3 = 27$. Of the candidates who tried to solve the equations $\frac{T_2}{T_1} = \frac{T_3}{T_2} = \frac{T_4}{T_3}$ for *p* and *q* the most common error was to try to use just one of the three equations.

Question 9

(a) Most candidates knew the formula $V = \pi \int_a^b y^2 dx$. The expansion of $(x^2 + 1)^2$ was not well done. The most common error was $x^4 + 1$. Though the question clearly stated rotation about the *x*-axis, quite a few candidates rotated about the *y*-axis.

(b) (i) Many responses complicated the question by constructing tree diagrams.

(ii) Most responses that showed working were able to obtain at least one mark for demonstrating that the cards were not replaced.

(c) (i) Better responses recognised this as a ‘superannuation’ style question and were able to form the relevant series. However, many candidates were unable to determine the correct number of terms in the series. Use of the formula $S_n = \frac{a(r^n - 1)}{r - 1}$ was well done, although a common mistake was to use $a = 1$.

(ii) Most responses showed some understanding of the problem but did not write down correctly the steps necessary to obtain the correct answer. Often this involved incorrect use of brackets.

(iii) Only the better responses recognising the link between parts (ii) and (iii) were able to correctly answer this part.

Question 10

Candidates are reminded to attempt all questions of the paper and not to assume that marks cannot be gained in question 10.

(a) (i) This part was attempted by the majority of candidates. In successful responses, candidates recognised that the function values were to be read from the graph and applied the $A = \frac{h}{3}\left\{ f(a) + 4f(\frac{a+b}{2}) + f(b) \right\}$ version of Simpson's Rule. A number of candidates, perhaps assuming Question 10 was meant to be difficult, assumed the curve to be a sine function. Better responses made the link with the area under the curve and the displacement of the object. Candidates who attempted to use five function values increased the level of difficulty by not being able to read off clear function values.

(ii) The question asked when was the displacement of the object decreasing, ie $t > 5$. Many candidates included $t = 5$ or assumed the object was returning when the line had a negative slope, ie when the velocity was decreasing from $t = 4$ to $t = 6$. A number of candidates gave multiple answers, perhaps misinterpreting the question which asked 'during which time(s)' and assuming this implied there was more than one answer.

(iii) The instruction 'estimate' was misunderstood by candidates who did not determine a precise time. Responses to 'justify your answer' varied greatly from candidates roughly estimating a time, to speaking of changes in velocity and acceleration, to the correct responses which included either distances travelled or areas above and below the t-axis being equal. Many responses included the conclusion that the object would not return to the origin, due to the horizontal line starting at $t = 6$, despite the question asking when the object did return. Better responses linked the answer to part (i) to the area under the axis for t > 6.

(iv) Candidates are reminded to use a ruler when drawing the axes of graphs. The scales used on axes need to be clear and consistent. Candidates are advised not to place multiple attempts on the same axes. Sketches require important features of the curve such as turning points, points of inflexion, intercepts and straight lines to be clearly identified. Many candidates attempted unsuccessfully to include a point of inflexion at $t = 2$. Better responses correctly applied the information from part (ii) that 'the object is initially at the origin' in their sketch.

(b) (i) Successful candidates recognised the need to use L_1 and L_2 in the formula and that the formula required the sum of two terms. 'Formula for the sum' was interpreted by some candidates as requiring the 'sum of an arithmetic progression'. Care needs to be taken to ensure subscripts are not lost in working out, particularly at this stage in the paper where candidates may be rushing.

(ii) Typical responses included an attempt to differentiate the formula from (i). The most efficient method was to write the formula in terms of negative indices and use the function of a function rule. Many candidates attempted the function of a function rule but did not multiply by the coefficient of x. Giving the two terms a common denominator and applying the quotient rule inevitably led to errors and increased the difficulty of the question. If the correct derivative was found, successful candidates understood not to expand the cubic expressions but to take the cube root once the equation was manipulated.

Mathematics

2007 HSC Examination Mapping Grid

Question	Marks	Content	Syllabus outcomes
1 (a)	2	1.1	P3
1 (b)	2	1.4	P3, P4
1 (c)	2	1.1	P3
1 (d)	2	7.3	H5
1 (e)	2	1.3	P4
1 (f)	2	6.2	P4, P5
2 (a) (i)	2	8.8, 12.5	P7, P8, H5
2 (a) (ii)	2	8.9, 13.5	P7, P8, H5
2 (b) (i)	2	11.1, 13.7	P8, H5
2 (b) (ii)	3	11.2	P8, H5
2 (c)	3	8.4, 8.8, 13.5	P5, P6, P7, H5, H6
3 (a) (i)	1	6.5	P3, P4
3 (a) (ii)	1	6.7	P3, P4
3 (a) (iii)	2	6.2	P3, P4
3 (a) (iv)	2	6.8	H5, H9
3 (a) (v)	1	2.3	P4
3 (b) (i)	1	7.1, 7.5	P4, H5
3 (b) (ii)	1	7.1, 7.5	P4, H5
3 (b) (iii)	1	7.1, 7.5	P4, H5
3 (b) (iv)	2	7.1, 9.1	P4, H5
4 (a)	2	5.2, 13.1	P4, H5
4 (b) (i)	2	3.1, 3.3	H5
4 (b) (ii)	1	3.1	H5
4 (c) (i)	1	2.3, 13.1	H4, H5, H9
4 (c) (ii)	2	5.3, 13.1	H4, H5, H9
4 (c) (iii)	1	2.3	H4, H5, H9
4 (c) (iv)	1	13.1	H5
4 (c) (v)	2	13.1	H4, H5, H9
5 (a) (i)	1	2.4	P2, H2, H5, H9
5 (a) (ii)	2	2.4	P2, H2, H5, H9
5 (a) (iii)	2	2.4	P2, H2, H5, H9
5 (b) (i)	1	14.3	H4, H5

Question	Marks	Content	Syllabus outcomes
5 (b) (ii)	2	14.3	H4, H5
5 (b) (iii)	1	14.3	H4, H5, H9
5 (b) (iv)	3	14.3	H3, H4, H5, H9
6 (a)	2	9.4, 12.1, 12.4	H3
6 (b) (i)	2	10.5	H5
6 (b) (ii)	4	10.2, 10.3, 10.4	H6
6 (b) (iii)	1	10.4	H6
6 (b) (iv)	3	10.5	H9
7 (a) (i)	2	9.5	P4
7 (a) (ii)	1	1.4, 9.3	P2, P4
7 (a) (iii)	1	1.4, 9.3	P3, P4
7 (a) (iv)	2	10.0, 10.1	P3, P4
7 (a) (v)	1	6.2, 9.5	P4
7 (b) (i)	2	5.2, 13.1	P4, H5
7 (b) (ii)	3	11.4	H8, H9
8 (a) (i)	3	1.4, 14.2	H3, H4, H9
8 (a) (ii)	2	14.2	H3, H4, H9
8 (b) (i)	2	2.3, 2.5	H2, H5
8 (b) (ii)	2	2.3, 2.5	H2, H5
8 (b) (iii)	1	2.3, 7.2	H2, H4, H5
8 (b) (iv)	2	1.4, 7.2	H2, H4, H5
9 (a)	3	11.4	H4, H8
9 (b) (i)	1	3.1	H5
9 (b) (ii)	2	3.3	H5
9 (c) (i)	3	7.5	H4, H5
9 (c) (ii)	2	7.5	H4, H5
9 (c) (iii)	1	7.5	H4, H5
10 (a) (i)	2	11.3	H4, H8
10 (a) (ii)	1	14.3	H4, H8, H9
10 (a) (iii)	2	14.3	H4, H8
10 (a) (iv)	2	14.3	H4, H8, H9
10 (b) (i)	1	4.1	P3, P4
10 (b) (ii)	4	10.6	H2, H4, H5, H9

BOARD OF STUDIES
NEW SOUTH WALES

2007 HSC Mathematics
Marking Guidelines

Question 1 (a)

Outcomes assessed: P3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Correct evaluation of $\sqrt{\pi^2 + 5}$ OR • Evidence of correct rounding to two decimal places	1

Question 1 (b)

Outcomes assessed: P3, P4

MARKING GUIDELINES

Criteria	Marks
• Correct graph of the solution	2
• Correctly solves the inequality OR • Correctly graphs their solution	1

Question 1 (c)

Outcomes assessed: P3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Recognises the significance of the conjugate	1

Question 1 (d)

Outcomes assessed: H5

MARKING GUIDELINES

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

Question 1 (e)

Outcomes assessed: P4

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Solves $2x^2 + 5x - 12 = 0$ OR • Shows some understanding of factorisation	1

Question 1 (f)

Outcomes assessed: P4, P5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Calculates the gradient of the perpendicular OR • Finds a line through (–1, 3)	1

Question 2 (a) (i)

Outcomes assessed: P7, P8, H5

MARKING GUIDELINES

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

Question 2 (a) (ii)

Outcomes assessed: P7, P8, H5

MARKING GUIDELINES

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

Question 2 (b) (i)

Outcomes assessed: P8, H5

MARKING GUIDELINES

Criteria	Marks
• Correct primitive	2
• Correct primitive of either term	1

Question 2 (b) (ii)

Outcomes assessed: P8, H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Attempts to substitute into correct primitive or equivalent merit	2
• Primitive of the form Ax^{-1} or equivalent merit	1

Question 2 (c)

Outcomes assessed: P5, P6, P7, H5, H6

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Finds the gradient at P	2
• Differentiates $x \sin x$ or equivalent merit	1

Question 3 (a) (i)

Outcomes assessed: P3, P4

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 3 (a) (ii)

Outcomes assessed: P3, P4

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 3 (a) (iii)

Outcomes assessed: P3, P4

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Calculates one relevant gradient	1

Question 3 (a) (iv)

Outcomes assessed: H5, H9

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Finds midpoint of *OB*	1

Question 3 (a) (v)

Outcomes assessed: P4

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 3 (b) (i)

Outcomes assessed: P4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 3 (b) (ii)

Outcomes assessed: P4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 3 (b) (iii)

Outcomes assessed: P4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 3 (b) (iv)

Outcomes assessed: P4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Sets up an appropriate quadratic equation	1

Question 4 (a)

Outcomes assessed: P4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Finds one solution	1

Question 4 (b) (i)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Recognises some of the combinations which give 10 or the size of the sample space	1

Question 4 (b) (ii)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 4 (c) (i)

Outcomes assessed: H4, H5, H9

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 4 (c) (ii)

Outcomes assessed: H4, H5, H9

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Finds one correct angle or equivalent merit	1

Question 4 (c) (iii)

Outcomes assessed: H4, H5, H9

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 4 (c) (iv)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 4 (c) (v)

Outcomes assessed: H4, H5, H9

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Makes some progress	1

Question 5 (a) (i)

Outcomes assessed: P2, H2, H5, H9

MARKING GUIDELINES

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

Question 5 (a) (ii)

Outcomes assessed: P2, H2, H5, H9

MARKING GUIDELINES

Criteria	Marks
• Correct solution. Justifications (abbreviated or otherwise) which indicate the appropriate geometric fact are acceptable	2
• Recognises that ΔABC is isosceles	1

Question 5 (a) (iii)

Outcomes assessed: P2, H2, H5, H9

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 5 (b) (i)

Outcomes assessed: H4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 5 (b) (ii)

Outcomes assessed: H4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Attempts to differentiate	1

Question 5 (b) (iii)

Outcomes assessed: H4, H5, H9

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 5 (b) (iv)

Outcomes assessed: H3, H4, H5, H9

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Evaluates the constant of integration OR • Attempts to evaluate $\int_0^4 \frac{2t\,dt}{16+t^2}$	2
• Finds a primitive of $\frac{2t}{16+t^2}$	1

Question 6 (a)

Outcomes assessed: H3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Obtains $e^x = \frac{1}{2}$ or equivalent merit	1

Question 6 (b) (i)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Finds either point or equivalent merit	1

Question 6 (b) (ii)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Correct solution	4
• Finds both stationary points and correctly applies an appropriate test	3
• Finds the x-coordinates of both stationary points	2
• Finds the derivative	1

Question 6 (b) (iii)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 6 (b) (iv)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• Correct sketch	3
• Graph of a quartic consistent with most of the features from the earlier parts	2
• Graph of a correctly oriented quartic or a graph showing several of the features from the earlier parts	1

Question 7 (a) (i)

Outcomes assessed: P4

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Finds vertex or the focal length	1

Question 7 (a) (ii)

Outcomes assessed: P2, P4

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 7 (a) (iii)

Outcomes assessed: P3, P4

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 7 (a) (iv)

Outcomes assessed: P3, P4

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Finds one of the coordinates of P, or equivalent merit	1

Question 7 (a) (v)

Outcomes assessed: P4

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 7 (b) (i)

Outcomes assessed: P4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Reduces to one equation involving $\tan x$ or equivalent merit	1

Question 7 (b) (ii)

Outcomes assessed: H8, H9

MARKING GUIDELINES

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

Question 8 (a) (i)

Outcomes assessed: H3, H4, H9

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Finds e^k or equivalent progress	2
• Writes down one of the two equations implied by the data	1

Question 8 (a) (ii)

Outcomes assessed: H3, H4, H9

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Finds the appropriate value of t	1

Question 8 (b) (i)

Outcomes assessed: H2, H5

MARKING GUIDELINES

Criteria	Marks
• Correct proof. Justifications (abbreviated or otherwise) which indicate the appropriate geometric fact are acceptable	2
• Proof without justification	1

Question 8 (b) (ii)

Outcomes assessed: H2, H5

MARKING GUIDELINES

Criteria	Marks
• Correct proof. Justifications (abbreviated or otherwise) which indicate the appropriate geometric fact are acceptable	2
• Proof without justification	1

Question 8 (b) (iii)

Outcomes assessed: H2, H4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 8 (b) (iv)

Outcomes assessed: H2, H4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Some progress towards finding the common ratio	1

Question 9 (a)

Outcomes assessed: H4, H8

MARKING GUIDELINES

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

Question 9 (b) (i)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 9 (b) (ii)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Demonstrates some understanding of this problem	1

Question 9 (c) (i)

Outcomes assessed: H4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Attempts to sum the first 18 terms of the appropriate geometric series	2
• Forms a geometric series	1

Question 9 (c) (ii)

Outcomes assessed: H4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Makes some progress	1

Question 9 (c) (iii)

Outcomes assessed: H4, H5

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 10 (a) (i)

Outcomes assessed: H4, H8

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Shows some understanding of Simpson's rule	1

Question 10 (a) (ii)

Outcomes assessed: H4, H8, H9

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 10 (a) (iii)

Outcomes assessed: H4, H8

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Shows some understanding of the need to balance the areas	1

Question 10 (a) (iv)

Outcomes assessed: H4, H8, H9

MARKING GUIDELINES

Criteria	Marks
• Correct sketch	2
• Graph consistent with some of the given information	1

Question 10 (b) (i)

Outcomes assessed: P3, P4

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 10 (b) (ii)

Outcomes assessed: H2, H4, H5, H9

MARKING GUIDELINES

Criteria	Marks
• Correct solution	4
• Obtains $\frac{m-x}{x} = \sqrt[3]{\frac{L_2}{L_1}}$ or equivalent merit	3
• Correctly differentiates the expression for the sum of the noise levels	2
• Attempts to differentiate a correct expression for the sum of the noise levels or equivalent merit	1