2006 HSC Notes from the Marking Centre Mathematics Extension 1

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2006 HSC NOTES FROM THE MARKING CENTRE MATHEMATICS EXTENSION 1

Introduction

This document has been produced for the teachers and candidates of the Stage 6 course, Mathematics Extension 1. It is based on comments provided by markers on each of the questions from the Mathematics Extension 1 paper. The comments outline common sources of error and contain advice on examination technique and how best to present answers for certain types of questions.

It is essential for this document to be read in conjunction with the relevant syllabus, the 2006 Higher School Certificate examination, the marking guidelines and other support documents that have been developed by the Board of Studies to assist in the teaching and learning of the Mathematics Extension 1 course.

As a general comment, candidates need to read the questions carefully and set out their working clearly. In answering parts of questions candidates should always state the relevant formulae and the information they use to substitute into the formulae. In general, candidates who do this make fewer mistakes and, when mistakes are made, marks are able to be awarded for the working shown. It is unwise to do working on the question paper, and if a question part is worth more than 1 mark the examiners expect more than just a bald answer. Any rough working should be included in the answer booklet for the question to which it applies.

Question 1

This question was attempted by almost all candidates and the majority answered it well. Part (e) caused candidates the most difficulty.

(a) This part was done well, demonstrating that most candidates were able to use the table of standard integrals. The predominant careless error was writing 'tan' rather than '$\tan^{-1}$'. The few candidates who did not recognise the integral thought that the answer involved logarithms.

(b) This part was done well. Most candidates had a solid understanding of integration by substitution and could manipulate the integral to a successful outcome, although many candidates did forget to replace the *u* with $x^4 + 8$ at the completion of the process. Candidates who attempted to make *x* the subject were usually unsuccessful, as they had difficulties with the algebra, and candidates who left the integral as a mixture of variables (ie $\int x^3 u^{\frac{1}{2}} du$) also usually did not answer the question correctly. If a careless error was made, it occurred during the differentiation of *u*. The most common such error was $\frac{du}{dx} = 3x^2$.

(c) Many candidates arrived at the correct answer of $\frac{5}{3}$ without reasonable justification. Most candidates understood that, as $\theta \to 0$, $\lim \frac{\sin\theta}{\theta} = 1$, but they had difficulty with the algebraic manipulation. Some candidates made the mistake of modifying the $5x$ within the sine function.

(d) The candidates who could not remember how to factorise the sum of two cubes and who used other methods, including the expansion of $(\sin\theta + \cos\theta)^3$, had more difficulty obtaining the final result. Many candidates did not notice the '– 1' or thought it was '=1'.

(e) This part was not done as well as the earlier parts in the question. Many candidates did not recognise the relationship between $\frac{d}{dx}(x^3)$ and 12 (gradient of the tangent). It was common to see candidates attempt to solve simultaneously and use $\Delta = 0$ with the equation $x^3 - 12x - b = 0$. For those candidates who saw the connection, many thought that $3x^2 = 12x$ or thought that, because $y = 12x + b$ was a tangent, there could only be one value of b. Several candidates recognised that b was the y-intercept of the tangent but then substituted $y = 0$.

Question 2

(a) The three parts of this question all referred to the function $f(x) = \sin^{-1}(x + 5)$.

(i) Candidates were required to state the domain and range of the function. Many were able to do this but some confused the terms 'domain' and 'range'. Also, the endpoints for the x and y values were sometimes exchanged, resulting in the incorrect statement of domain $-\frac{\pi}{2} \le x \le \frac{\pi}{2}$. Carelessness with the inequality signs was also a feature of some responses.

(ii) To find the gradient of the function at $x = -5$, most candidates were able to correctly state the derivative, although $\frac{1}{\sqrt{1-x^2}}$ and $\frac{1}{\sqrt{1+(x+5)^2}}$ were common errors. In the better responses, candidates substituted $x = -5$ directly into the derivative without expanding $(x + 5)^2$, thus avoiding algebraic errors and unnecessarily complicated calculation.

(iii) A wide variety of responses were given for this part. In the better responses, candidates drew clear graphs, with axes and endpoints clearly shown. Many of the graphs drawn, however, contradicted answers to either part (i) or part (ii). The domain and/or the range differed from the answer in part (i), or the graph was drawn as a decreasing curve although the gradient was stated as equal to 1 in part (ii). The concavity of the curve was often reversed.

(b) (i) Correct application of the binomial theorem to expand $(1 + x)^n$ enabled candidates to differentiate and state the derivative as given in the question. Some candidates omitted either the first or last terms, which prevented them from showing the result as required.

(ii) Substitution of $x = 2$ into the given expression needed to be shown.

(c) (i) Substitution of $x = 0$ into the given equation of PR was required to find the coordinates of U. This simple substitution was made difficult or time consuming by deriving the equation of PR, even though 'Do NOT prove this.' was written on the examination paper, or by resubstituting the y-value into the equation to find x. Many candidates who found $y = -apr$ subsequently changed their answer to $y = (+)apr$ in the mistaken belief that, since U was above the x-axis, apr had to be positive.

(ii) Most candidates were able to solve the simultaneous equations correctly, although algebraic errors were not uncommon. Candidates who chose to substitute into the equations often only substituted into one equation. Again, much time was wasted in deriving the equations of the tangents despite candidates being instructed not to do so.

(iii) Only a minority of candidates were able to show that TU was perpendicular to the axis of the parabola. Since QR was given as perpendicular to the axis, it was necessary to realise that the symmetry of the parabola or the gradient of QR implied that $q+r = 0$ or $q = -r$. Hence it could be stated that the gradient of TU (which most found) was equal to zero or that the y values of T and U were equal. Many candidates were able to find the gradients of QR and TU but were unable to make the required connection. Another common error occurred when candidates found that since the y values aq^2 and ar^2 are equal, then $q^2 = r^2$, thus leading them to state $q = r$ to agree with their incorrect answer to part (i).

Question 3

(a) Most of the candidates who used the identity for $\sin^2 x$ in terms of $\cos 2x$ were able to obtain full marks. Candidates who relied on the formula for $\int \sin^2 x \, dx$ often misquoted the formula or made arithmetical errors.

(b) (i) Candidates who simply substituted to show that $f(1.5) < 0$ and $f(2) > 0$ were the most successful. Those candidates who attempted to demonstrate that $3\log_e x < x$ at $x = 1.5$ and $3\log_e x > x$ at $x = 2$ often failed to explain their reasoning adequately. Candidates who converted the given expression into an exponential expression rarely obtained the correct solution.

(ii) Candidates who correctly quoted Newton's method usually obtained full marks. A significant number of candidates were unable to derive the correct expression for $f'(x)$, but were then able to demonstrate understanding of Newton's method of approximation of roots.

(c) Many candidates were unable to recognise that the question involved arrangements, not combinations. Most candidates appreciated that the sum of the number of different arrangements of two-, three-, four-, and five-block towers was required in part (ii), but many still used calculations implying combination methods.

(d) This part was poorly answered or ignored by many candidates. Some candidates made statements suggesting that they had marked angles on the diagram in their examination paper, but were unable to transfer their reasoning to a correct written statement. Many candidates were unfamiliar with basic terminology and were unable to express reasons in a convincing manner. Parts (i) and (ii) were usually attempted but part (iii) was frequently not attempted.

Question 4

(a) This part was poorly done by many candidates who did a great deal of work but did not calculate either r or $s + t$. Those candidates using the 'sum of roots' method were the most successful in part (i). If this was followed by evaluation of $P(1) = 0$ in part (ii), candidates received full marks for three lines of working. The 'product of roots and sum of roots two at a time' was also a successful method for part (ii). Many candidates who used either the factor theorem with α or $-\alpha$, or expanded the product and equated coefficients, made errors or did pages of working without obtaining either answer. A number of candidates made careless algebraic errors, in particular finding $-r = 1$ and then writing $r = 1$.

(b) This part was very poorly done. Many candidates knew that part (i) required some version of $x = a\cos(nt+\alpha)$ or $x = a\sin(nt+\alpha)$, but failed to find the correct n or α. A number of candidates did not know where to start. Even though 'follow-through' marks were awarded for part (ii) answers consistent with incorrect answers to part (i), many candidates used 0 or 18 as x rather than 9, or they differentiated first, showing an inability to translate the given words into a mathematical form. A common error was obtaining $t = \frac{5}{8}$ by assuming the velocity was constant, or $t = \frac{5}{3}$ because candidates found $\cos^{-1}\frac{1}{2} = \frac{\pi}{6}$.

(c) (i) This part was done well, with most candidates gaining at least one mark. The most common errors were ignoring c or calculating it incorrectly. A number of candidates found $v = \int a(x)\,dx$ rather than $\frac{1}{2}v^2$. The most efficient solution used the definite integrals $\int_{-6}^{v} v\,dv = \int_{-2}^{x} a(x)\,dx$.

(ii) Approximately half the candidates recognised that v had to be negative, but very few candidates gave a correct explanation. A number of candidates tried to integrate the expression. This was not required. The manipulation of the integral from a derivative was poorly handled with poor notation and incomplete steps, though credit was given if candidates indicated an understanding of the process.

(iii) This part was done well, with most candidates either being able to calculate c or convert the given expression to an exponential for one mark. Again, poor algebraic manipulation skills meant that many candidates did not obtain the correct final answer for full marks on this part of the question.

Question 5

On the whole, this question was done well, with very few non-attempts.

(a) Most candidates were able to score two marks on this part. The most popular approach was to find $\frac{dy}{dt}$ and this enabled candidates to gain full marks with little difficulty. Candidates who tried to integrate $t = \int \frac{-1}{0.7(y-3)}\,dy$ were not only slowed down but also made mistakes in dealing with the constant. A few candidates quoted the formulae: $\frac{dN}{dt} = k(N - N_0), N = N_0 + Ae^{kt}$. Some candidates stated that since the given equations were in this form then one must be a solution of the other. These candidates were expected to 'show' that this was true.

(b) Most candidates approached this part by actually finding the inverse function by swapping *x* and *y*. This was the most successful method. Some candidates found the first derivative and showed that the function was always increasing. There were few errors in finding the first derivative. Those candidates who sketched the graph were unable to score full marks unless they had graphed the function with the use of calculus, thus being certain of no turning points. Most of the candidates who used a graphical approach simply drew an almost correct graph and stated that the 'horizontal-line test' worked. Some candidates' responses demonstrated confusion regarding terms such as '1:1' and statements such as 'for every value of *x* there is only one *y*'. A number of candidates found *f(–x)*.

(c) (i) Most candidates scored full marks on this part. They correctly quoted the appropriate chain rule and found $\frac{dV}{dx}$. However, those candidates who differentiated using the product rule made algebraic errors more often than those who expanded first. A few candidates used the *r* as a variable in the chain rule, not realizing that *r* (the radius of the bowl) was a constant.

(ii) Most candidates substituted into $\frac{dx}{dt}$ from part (i) without clearly demonstrating an understanding of the significance of this derivative. Some candidates determined *t* by integrating and successfully found the two times. A smaller number of candidates could not simplify the resulting algebraic expressions successfully. The third option was to substitute into the given equation for *V*, but most of the candidates who chose this method did not explain that this was possible because $V=kt$.

(d) (i) This part was not done well, with many candidates presenting circular arguments. However, a number of candidates successfully rearranged the given fact and easily saw the substitution required. Many candidates spent considerable time on this part, which was worth only one mark.

(ii) Most candidates attempted this part. However, many only earned the mark for stating the inductive step. They could not prove the expression true for n=1 as they were not able to use part (i), and consequently not able to prove the inductive step.

Question 6

(a) Where a part required candidates to 'show' a given result, they needed to present sufficient working to convince the markers that they had arrived at the given answer by their own reasoning. Markers cannot assume that candidates have performed all intermediate steps in working such as $\sqrt{\frac{a^2\cos^2\theta}{2(1-\sin\theta)} - \frac{a^2\cos^2\theta}{(1-\sin\theta)} + a^2} = a\sqrt{\frac{1-\sin\theta}{2}}$.

(i) This part was done well by those candidates who recognised that they needed to apply Pythagoras' theorem or the distance formula. The main errors were omitting or changing terms when going from one line to the next, using the incorrect formula $(x_2 + x_1)^2 - (y_2 + y_1)^2$, or writing the y term as $(Vt\sin\theta - \frac{1}{2}gt^2 - Vt - \frac{1}{2}gt^2)^2$.

(ii) Candidates found it difficult to gain full marks in this part. Many did not read the question properly and only found the minimum value of L from the given value of t. Candidates who differentiated L^2 performed better than those who took the square root and differentiated L, although many did not know what to call $\frac{d(L^2)}{dt}$. On this occasion the emphasis was placed on the differentiation rather than what to call the derivative. Many candidates omitted parts of the formula given for L^2 when they substituted. Those candidates who recognised that L^2 was a quadratic function were often able to obtain the required value for t using $t = \frac{-b}{2a}$.

(iii) Very few candidates attempted this part and only a small number of these candidates were able to show the result.

(b) (i) Candidates needed to 'show' how the '4' was obtained by use of the binomial co-efficient, an adequate diagram or the expansion of $(p + q)^4$.

(ii) In this part, the wording 'in terms of q' was sometimes overlooked. Candidates who used the complement of part (i) often made errors in expressing this fact, writing $1 - 4pq^3 + q^4$ rather than $1 - 4pq^3 - q^4$. Some candidates incorrectly substituted $q - 1$ or $1 + q$ for p. Candidates who gave their answer as $6(1 - q)^2q^2 + 4(1 - q)^3q + (1 - q)^4$ had difficulty obtaining marks in part (iv).

(iii) Candidates who used the expression $p^2 + 2pq$ experienced difficulties when substituting and simplifying their answer.

(iv) Candidates who had left their answers to parts (ii) and (iii) in a complicated form had difficulty expanding and collecting the like terms onto one side of the inequality to obtain the first mark. Some candidates divided both sides of the inequality by a common factor, hence eliminating critical points. Many candidates had negative values or values greater than 1 for q. Many candidates who did have the solution $\frac{1}{3}<q<1$ also included $q = 0$ or $q<0$, failing to recognise the implication of the double root at $q = 0$.

Question 7

This question contained five related parts. The vast majority of candidates attempted this question. Candidates are reminded to show all working, take care with notation and setting out, and use the number of marks allocated to each part of the question as a guide to the amount of working required.

(a) Most candidates were able to deduce the correct area, either subtracting the area of the triangle from the area of the sector or substituting the angle 2θ into the formula for the area of a segment of a circle. Care needed to be taken with arithmetic and algebraic substitutions and the use of appropriate terminology.

(b) Candidates who substituted $r = \frac{w}{2\theta}$ into the expression for A given in part (a), and then differentiated A as a function of θ, were generally able to gain the first two marks for this part. Those candidates who used $\sin\theta\cos\theta = \frac{1}{2}\sin 2\theta$ prior to differentiating, simplified the process and were able to gain full marks more often. Candidates are reminded of the need to express all variables (r in this case) in terms of θ before differentiating with respect to θ. When the required result is given, it is important that candidates show sufficient working to convince markers that the correct processes were followed.

(c) The majority of candidates attempting this part understood the need to differentiate $\sin\theta - \theta\cos\theta$ and to indicate that this derivative was positive for $0 < \theta < \pi$, implying an increasing function. In the better responses, candidates also correctly indicated $g(0) = 0$, ensuring $g(\theta) > 0$ for the given domain.

(d) In the better responses, candidates used the result in part (c) to assist them to obtain the solution to this part. Candidates who recognised that the solution to $\cos\theta = 0$ provided the only solution to $\frac{dA}{d\theta} = 0$ were able to gain one of the two marks for this part. Candidates are reminded that the domain needs to be taken into account when finding solutions to trigonometric equations.

(e) Candidates are reminded to note the mark allocation for individual parts of a question and to show calculated values when proving a result given in the question (in this case for the maximum cross-sectional area). Attempts that used the second derivative involved a significant amount of working for one of the two marks in this part and were rarely successful. In the better responses, candidates recognised that $\cos\theta$ was the only term in the expression that was not positive for all values in the domain and used this fact, checking the sign of the first derivative on either side of $\theta = \frac{\pi}{2}$, to show the maximum turning point. Those candidates who substituted $\theta = \frac{\pi}{2}$ into their area expression in terms of θ from part (b) were generally able to gain the second mark.

Mathematics Extension 1

2006 HSC Examination Mapping Grid

Question	Marks	Content	Syllabus outcomes
1 (a)	2	15.5E	HE4
1 (b)	3	11.5E	HE6
1 (c)	2	13.4E	HE3
1 (d)	2	1.3, 5.2, 13.1	P3, H5
1 (e)	3	8.4, 8.9	P6
2 (a) (i)	2	4.1, 15.2E	HE4
2 (a) (ii)	2	15.5E	PE5, HE4
2 (a) (iii)	2	15.3E	HE4
2 (b) (i)	1	17.1E, 17.3E	HE3
2 (b) (ii)	1	17.1E, 17.3E	HE3
2 (c) (i)	1	6.2, 9.6E	PE3
2 (c) (ii)	2	6.3, 9.6E	PE3
2 (c) (iii)	1	6.2, 9.6E	PE3
3 (a)	2	13.6E	HE6
3 (b) (i)	1	16.4E	HE7
3 (b) (ii)	2	16.4E	HE4, HE7
3 (c) (i)	1	18.1E	PE3
3 (c) (ii)	2	18.1E	PE3
3 (d) (i)	1	2.10E	PE3
3 (d) (ii)	1	2.10E	PE3
3 (d) (iii)	2	2.10E	PE2, PE3
4 (a) (i)	1	16.3E	PE3
4 (a) (ii)	2	16.3E	PE3
4 (b) (i)	1	14.4E	HE3
4 (b) (ii)	2	14.4E	HE3
4 (c) (i)	2	14.3E	HE5
4 (c) (ii)	2	14.3E	HE2, HE5
4 (c) (iii)	2	12.3, 14.3E	H3, HE5
5 (a)	2	12.5	HE3

Question	Marks	Content	Syllabus outcomes
5 (b)	2	15.1E	HE4
5 (c) (i)	2	14.1E	HE5
5 (c) (ii)	2	14.1E	HE5
5 (d) (i)	1	5.7E	P4, PE2
5 (d) (ii)	3	7.4E	HE2
6 (a) (i)	2	5.2, 6.5, 14.3E	P3, P4, HE3
6 (a) (ii)	3	5.2, 6.5, 14.3E	P3, P4, HE3
6 (a) (iii)	1	5.2, 6.5, 14.3E	P3, P4, HE3
6 (b) (i)	1	18.2E	HE3
6 (b) (ii)	2	18.2E	HE3
6 (b) (iii)	1	18.2E	HE3
6 (b) (iv)	2	1.4E, 18.2E	PE3, HE3
7 (a)	2	5.5, 13.1	H5
7 (b)	3	13.5	H5
7 (c)	3	13.5, 10.1	H5, H9, HE7
7 (d)	2	5.2, 10.2, 13.1	H5, H9, HE7
7 (e)	2	10.6, 13.1	H5, H9, HE7

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2006 HSC Mathematics Extension 1
Marking Guidelines

Question 1 (a)

Outcomes assessed: HE4

MARKING GUIDELINES

Criteria	Marks
• Correct primitive	2
• An answer in the form $A\tan^{-1}Bx$ or equivalent merit	1

Question 1 (b)

Outcomes assessed: HE6

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Makes substantial progress	2
• Displays some understanding of the method of substitution	1

Question 1 (c)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Applies $\lim\limits_{x\to 0}\frac{\sin x}{x}=1$ or equivalent merit	1

Question 1 (d)

Outcomes assessed: P3, H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Demonstrates some knowledge of the factorisation of the sum of cubes	1

Question 1 (e)

Outcomes assessed: P6

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Finds one value of b or equivalent merit	2
• Attempts to equate the gradients of the line and the curve	1

Question 2 (a) (i)

Outcomes assessed: HE4

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Correct range or domain or equivalent merit	1

Question 2 (a) (ii)

Outcomes assessed: PE5, HE4

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Shows some understanding of $\frac{d}{dx}\sin^{-1} x$	1

Question 2 (a) (iii)

Outcomes assessed: HE4

MARKING GUIDELINES

Criteria	Marks
• Correct sketch	2
• Graph consistent with domain and range given in part (a) (i) or equivalent) merit)	1

Question 2 (b) (i)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 2 (b) (ii)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 2 (c) (i)

Outcomes assessed: PE3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 2 (c) (ii)

Outcomes assessed: PE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Attempts to solve the equations simultaneously or equivalent merit	1

Question 2 (c) (iii)

Outcomes assessed: PE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 3 (a)

Outcomes assessed: HE6

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Correct use of double angle formula or equivalent merit	1

Question 3 (b) (i)

Outcomes assessed: HE7

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 3 (b) (ii)

Outcomes assessed: HE4, HE7

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Demonstrates some understanding of Newton’s method	1

Question 3 (c) (i)

Outcomes assessed: PE3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 3 (c) (ii)

Outcomes assessed: PE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Makes substantial progress	1

Question 3 (d) (i)

Outcomes assessed: PE3

MARKING GUIDELINES

Criteria	Marks
• Correct proof	1

Question 3 (d) (ii)

Outcomes assessed: PE3

MARKING GUIDELINES

Criteria	Marks
• Correct proof	1

Question 3 (d) (iii)

Outcomes assessed: PE2, PE3

MARKING GUIDELINES

Criteria	Marks
• Correct proof	2
• Shows that $\angle PTN = \angle KQT$ with appropriate justification or equivalent merit	1

Question 4 (a) (i)

Outcomes assessed: PE3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 4 (a) (ii)

Outcomes assessed: PE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Expresses s or t in terms of α or equivalent merit	1

Question 4 (b) (i)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 4 (b) (ii)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Makes substantial progress	1

Question 4 (c) (i)

Outcomes assessed: HE5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Applies $\ddot{x} = \frac{d}{dx}\left(\frac{1}{2}v^2\right)$	1

Question 4 (c) (ii)

Outcomes assessed: HE2, HE5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Establishes that $v \quad -3x(1+x)$ or equivalent merit	1

Question 4 (c) (iii)

Outcomes assessed: H3, HE5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Makes some progress	1

Question 5 (a)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Calculates y' or equivalent merit	1

Question 5 (b)

Outcomes assessed: HE4

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Differentiates (x) correctly or equivalent merit	1

Question 5 (c) (i)

Outcomes assessed: HE5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Applies the chain rule or equivalent merit	1

Question 5 (c) (ii)

Outcomes assessed: HE5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Expresses t as a primitive involving x or equivalent merit	1

Question 5 (d) (i)

Outcomes assessed: P4, PE2

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 5 (d) (ii)

Outcomes assessed: HE2

MARKING GUIDELINES

Criteria	Marks
• Correct proof	3
• Correctly proves the inductive step OR • Verifies the case $n = 1$ and attempts to prove the inductive step	2
• Verifies the case $n = 1$ correctly or equivalent merit	1

Question 6 (a) (i)

Outcomes assessed: P3, P4, HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Attempts to apply the distance formula	1

Question 6 (a) (ii)

Outcomes assessed: P3, P4, HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Finds the value of t for which L^2 is a minimum and makes some progress in simplifying this expression	2
• Shows that $\frac{d}{dt}\left(L^2\right) = 0$ when t has the given value	1

Question 6 (a) (iii)

Outcomes assessed: P3, P4, HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 6 (b) (i)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 6 (b) (ii)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Identifies the complementary event or equivalent merit	1

Question 6 (b) (iii)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 6 (b) (iv)

Outcomes assessed: PE3, HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Makes some progress towards the solution of an appropriate inequality	1

Question 7 (a)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Writes the area of the cross-section as the difference of two areas, or equivalent merit	1

Question 7 (b)

Outcomes assessed: H5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Obtains an expression for $\frac{dA}{d\theta}$ in terms of w and θ	2
• Writes A in terms of w and θ or equivalent merit	1

Question 7 (c)

Outcomes assessed: H5, H9, HE7

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Observes $g(\theta$ is an increasing function or equivalent merit	2
• Differentiates $g(\theta$ correctly	1

Question 7 (d)

Outcomes assessed: H5, H9, HE7

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Observes that $\cos\theta = 0$ when $\theta = \frac{\pi}{2}$ or equivalent merit	1

Question 7 (e)

Outcomes assessed: H5, H9, HE7

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Shows that the stationary point is a maximum or finds the maximum area	1