2008 HSC Notes from the Marking Centre Mathematics Extension 1

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2008 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 in Mathematics Extension 1. 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 Extension 1.

Question 1

(a) In better responses, most candidates used the remainder theorem to obtain the correct answer. Those who chose to attempt the division tended to make arithmetic errors. It was of great concern to note a high percentage of those responses that accurately completed division obtaining the answer of -27, then stated that the remainder was 27.

(b) The only common error in this part was forgetting to multiply by the derivative of $3x$.

(c) In better responses, candidates used the table of integrals very well. A common mistake made in the evaluation of $\left[\sin^{-1}\frac{x}{2}\right]_{-1}^{1}$ was obtaining the incorrect answer $\sin^{-1}\frac{1}{2} - \sin^{-1}1$. Candidates are reminded to use radians when evaluating inverse trigonometric functions.

(d) Better responses used ${}^{12}C_k(2x)^{12-k}(3y)^k$ to find $k = 4$ and then substituted correctly. Common errors arose from using the formula $T_{k+1} = {}^{12}C_k(2x)^{12-k}(3y)^k$, deciding that T_5 was the correct term but then using $k = 5$. Other errors included the lack of brackets so that 2 and 3 were used without indices. A number of candidates obtained ${}^{12}C_8(2x)^8(3y)^4$ but then went on to state that the coefficient was only ${}^{12}C_8$. A large number of candidates, having found the correct answer 10 620 324, then crossed that out and replaced it with ${}^{12}C_8 2^8 3^4$ as the coefficient, thus wasting time. Of concern was the fact that many changed 2 to 12, confusing the 12 on ${}^{12}C_8$ with the 2.

(e) In better responses, candidates recognised that the integrand had the form $f'(x)\ \sin^2\left(f(x)\right)$ and were immediately successful. Weaker responses attempted the substitution of $\frac{1}{2} - \frac{1}{2}\cos 2\theta$ or $1 - \cos^2\theta$ for $\sin^2\theta$ or the substitution of $\frac{\sin 2\theta}{2}$ for $\cos\theta$; almost all of these attempts were unsuccessful. Many attempted the substitution $u = \sin\theta$ with good results. Substitution of $u = \sin^2\theta$ or $u = \cos\theta$ was not as successful. A number of weaker responses assumed that the integral $\int \cos\theta \sin^2\theta\, d\theta$ could be rewritten as $\int \cos\theta\, d\theta \int \sin^2\theta\, d\theta$ with a few simply writing down the incorrect primitive $\sin\theta\left(\frac{1}{2}\theta - \frac{1}{4}\sin 2\theta\right)$ with no working shown.

(f) Most candidates recognised that $x = 3$ and $x = 5$ had some significance to the domain. Most then recognised that $x \neq 3$ and $x \neq 5$, continuing on to correctly solve $(x - 3)(5 - x) > 0$. In weaker responses, candidates did not recall that in $\log f(x)$, $f(x)$ cannot be negative or zero. A common mistake was to solve $(x - 3)(5 - x) > 0$ by finding $(x - 3) > 0$ and $(5 - x) > 0$, thus obtaining the correct result by incomplete means.

Question 2

(a) In better responses, candidates handled the substitution, including differentiating $u = \ln x$, successfully. Most of those were subsequently able to change the limits to appropriate values of u. The integration of u^{-2} leading to $-u^{-1}$ was well done, apart from the few who differentiated instead. Difficulties arose for candidates who attempted to complete the question without changing the limits, being unable to complete the more difficult final substitutions in terms of x. Most errors arose after the substitution of the limits, resulting in common errors in the sum $-\frac{1}{2} - (-1) = -\frac{3}{2}$ or $-\left(\frac{1}{2} - 1\right) = -\frac{1}{2}$.

(b) In better responses, candidates integrated successfully and linked this to $\frac{1}{2}v^2$, but many arrived at the equation $v = \frac{1}{2}x^2 + 4x + c$ or made no mention of v in their equation. Some left their equations linked to $\dot{x}$, which showed a poor understanding of this topic. Basic arithmetic errors occurred when evaluating the constant, or when substituting $x = 2$.
A common incorrect solution to $c + \frac{9}{2} = 0$ was $c = \frac{9}{2}$.
Many weaker responses ignored the constant completely or assumed that the value of the constant was 0. Some weaker responses treated the question as if velocity had been given as a function of time, confusing integration with respect to x with integration with respect to t. Another common error was to leave the answer as $v^2 = 11$, rather than answering the question with the value of v.

(c) Successful attempts mostly used the sum and product of roots and substituted to eliminate a and then find α. Many candidates set up simultaneous equations by substituting the roots into the polynomial and successfully found either a and/or c but did not find α. A number of candidates mistakenly began with $P(2) = P(-3) = 0$. Candidates often took two full pages of working to solve their simultaneous equations. Some tried to expand factors and equate coefficients but had ignored a, hence oversimplifying the question by assuming they had a monic polynomial.

(d) In better responses, candidates demonstrated a good recall of Newton's method. Many ignored the need for radians in this question, and incorrectly used degrees. Most candidates

differentiated $f(x)$ but many did not remember where to put $f(4)$ and $f'(4)$ in their formula.
Commonly the derivative of $\tan(x)$ was confused with the derivative of $\tan^{-1}(x)$.
Responses that substituted 4 immediately into $\sec^2 x - \frac{1}{x}$ or $\frac{1}{\cos^2 x} - \frac{1}{x}$ were more successful than those who tried to use identities to simplify before their substitution.
Candidates who showed the substitution step into their formula were far more successful than those who simply gave an answer.

Question 3

(a) (i) Better responses produced the correct shaped graph. Weaker responses did not indicate the x-intercept.

(ii) In most responses, candidates located at least one of the solutions to the equation $|2x-1| = |x-3|$, but a significant number could not state the correct solution to the inequality $|2x-1| \leq |x-3|$. In better responses, candidates either sketched the graph of $y = |x-3|$ or solved the inequality $(2x-1)^2 \leq (x-3)^2$. In weaker responses, candidates attempted to remove the absolute value signs and consider positive and negative cases. Few responses using that method established correct inequalities from which to obtain the solution.

(b) Most candidates established that the statement is true for $n = 1$. Weaker responses did not show the use of $n = k$ in the proof. Candidates are reminded that when establishing the inductive step – assuming the statement is true for some $n = k$, and considering the case when $n = k + 1$ – all working out must be shown. Weaker responses could not use the substitution of $\frac{k}{6}(k+1)(2k+7)$ for $1 \times 3 + 2 \times 4 + \cdots + k(k+2)$ in the proof.

(c) (i) Weaker responses to this part did not fully justify the steps. Better responses used $\theta = \tan^{-1}\frac{x}{l}$, the chain rule and the notation $\frac{dx}{dt} = v$.

(ii) Candidates are reminded to look at the marks allocated for each part of each question. Many candidates attempted to differentiate the function in (i), failing to recognise that the maximum value of $\frac{d\theta}{dx}$ can be deduced by finding the minimum value of $l^2 + x^2$, that is, by substituting $x = 0$ into the expression from part (c)(i).

(iii) Candidates are reminded that answers must be given in radians, and lie within the interval given in the question, that is $-\frac{\pi}{2} < \theta < \frac{\pi}{2}$.

Question 4

(a) (i) Candidates who differentiated $T = 190 - 185e^{-kt}$ and showed, by substitution, that it satisfied the differential equation were more successful than those who tried to establish the result through integration. Care must be taken with setting out when asked to show that a result is true. Many candidates missed or felt it not necessary to show that this equation satisfied the initial condition of $T = 5^\circ C$.

(ii) Many candidates were able to use exact values throughout their solution. It is important for candidates to be able to judge the validity of their solution to a practical problem as a way of determining whether they have made an error in their calculations.

(b) (ii) Observing that the number sought was half the total number of arrangements, namely $\frac{8!}{2}$, was the most efficient method for calculating the number of permutations. Drawing a diagram to consider all cases was also successful. Many candidates who considered different cases subsequently combined their results incorrectly, by multiplication rather than addition.

(c) (i) Well set out solutions with clear logic were more successful. Mid-range responses found the gradient of QO but then many multiplied it by $\frac{p}{2}$ stating $\frac{p}{2} \times \frac{q}{2} = -1$ and therefore $pq = -2$.

(ii) It was important to relate the results in (c)(i) to this part. The most successful method simply stated that $\frac{p}{2} \times q = \frac{pq}{2} = \frac{-2}{2} = -1$. Some candidates who could not establish the result in part (i) nevertheless used the result to successfully complete part (ii).

(iii) In the better responses, candidates who recognised that $PQLK$ was a cyclic quadrilateral were quite efficient and effective at explaining why $ML = MK$. Those who tried coordinate geometry formulae found that it was nearly impossible to prove the result and so they spent valuable time completing large amounts of algebra to little benefit.

Question 5

(a) (i) Mid-range responses were awarded the first mark for a sketch of the function and its reflection in the line $y = x$. To gain a second mark, candidates needed to correctly consider the domain of the function and inverse. Better responses provided a clear diagram with endpoints written explicitly or indicated through the use of a scale.

(ii) Better responses indicated an understanding of inverse functions through swapping x and y, then attempting to make y the subject of the equation. Those who used $f^{-1}(x)$ notation throughout this process often had difficulty completing their calculations correctly. Better responses used the given domain to gain the correct expression for the inverse function.

(iii) In better responses, candidates substituted $x = \frac{3}{8}$ into their inverse function from part (ii). Some who did not find an inverse in the previous part were still able to gain this mark by substituting $y = \frac{3}{8}$ correctly into the original function and then correctly solving for x.

(b) Although many candidates wrote down correct simple harmonic motion equations, some did not gain any marks as they did not use the velocity or acceleration given in these equations. Confusion between acceleration and amplitude was evident in many responses. Some candidates who found the correct amplitude and value for n failed to calculate the period. Those who found an incorrect value for n were still able to gain a mark for calculating the period. The best responses showed a clear understanding of simple harmonic motion and often calculated the amplitude and period with very few lines of working. Candidates are reminded to read questions carefully to ensure they provide all required answers.

(c) The vast majority of candidates correctly copied the diagram into their answer booklet. Candidates are encouraged to write on their diagram, indicating the equal angles, to assist them in writing the proof. Better responses were provided by those candidates who had planned their response in a logical manner and provided reasoning to justify the statements in their proof.

Question 6

(a) (i) Most candidates successfully copied the diagram and correctly transcribed the information given in the question onto their diagram. Candidates are reminded that they may trace the given diagram, as there were many carelessly executed diagrams where it was sometimes difficult to read the given information on their diagram. Transcription errors also marred many solutions. Some candidates felt they needed to draw an ornate tower on their diagram and spent unnecessary time doing so.

(ii) Candidates were generally successful on this part of the question by stating a correct tan/cot ratio involving TO and either AO or BO or by stating the cosine rule correctly and substituting the correct values for AB and angle AOB. Many were then unable to successfully proceed from this point. Some had difficulty changing the subject of their tan/cot ratio to AO and BO so were unable to substitute correct expressions into the cosine rule. In weaker responses, candidates did not find the correct value of angle AOB. Candidates are reminded to learn basic formulae such as the cosine rule correctly. In mid-range responses candidates, after substituting correct expressions for AO and BO into the correct formula for cosine rule, could not manipulate their equation successfully to make TO the subject or to use their calculator successfully to find the value of TO. Candidates are also reminded not to round their answers too early in their calculations. Candidates who displayed facility with this part frequently used the complementary angles $67°$ and $58°$ in their tangent ratios.

(b) In better responses, candidates were generally successful on this part of the question by correctly substituting into the LHS of the equation for $\sin 3\theta$ and $\sin 2\theta$, although some candidates attempted to expand $\sin 3\theta$ and $\sin 2\theta$. Expanding these expressions was unnecessary, time-consuming and often futile. Many candidates misinterpreted this part of the question and instead of solving the equation attempted to prove an identity. Those candidates who solved the equation frequently did not obtain full marks as they either divided each side of their equation by $\sin\theta$, losing the solutions where $\sin\theta = 0$, or had difficulty with the algebraic manipulation and/or factorisation of their trigonometric equation. Candidates who solve equations by squaring both sides of the equation are reminded to check for extraneous solutions. Many solutions were marred by transcription errors. Responses that attempted to solve the equation by using $t = \tan\frac{\theta}{2}$ were unsuccessful. A minority of responses did not obtain full marks as they gave their solutions in degrees rather than the required radians.

(c) (i) Candidates who did attempt this part frequently gained a mark by successfully using the binomial theorem to expand $(1+x)^{p+q}$. Responses that used sigma notation were sometimes less successful than candidates who wrote out the sum showing at least three correct terms. Many candidates identified the term independent of x correctly but misinterpreted this part of the question by stating which term was independent of x rather than by giving the independent term or, by being careless in their use of notation, failed to gain this mark. A common error in many responses where the question was apparently understood was to state that the term independent of x was $\binom{p+q}{q} x^q$.

(ii) Candidates were generally able to gain one or two marks if they applied the binomial theorem and successfully expanded $(1+x)^p\left(1+\frac{1}{x}\right)^q$. Many candidates who otherwise gained full marks on this question did not obtain full marks for this part as they had not considered the restriction that $p \le q$ and gave their solution as

$$1+\binom{p}{1}\binom{q}{1}+\binom{p}{2}\binom{q}{2}+\ldots.+\binom{p}{q}\binom{q}{q}=\binom{p+q}{q}.$$

To gain full marks candidates were required to successfully expand the expression $(1+x)^p\left(1+\frac{1}{x}\right)^q$ or to show by multiplication how to obtain the

$1+\binom{p}{1}\binom{q}{1}+\binom{p}{2}\binom{q}{2}+\ldots.+\binom{p}{p}\binom{q}{p}$, $p \le q$, and to give a simpler expression by indicating that they were equating the terms independent of x in the identity

$$\frac{(1+x)^{p+q}}{x^q}=(1+x)^p\left(1+\frac{1}{x}\right)^q.$$

Question 7

Responses that treated this as a question on the parabola with algebraic manipulation were most successful. Candidates are reminded that if they are required to show that something is true then all steps of working must be justified.

(a) In better responses, candidates identified the answers as the sum and products of the roots of a quadratic equation in t and were most successful in this part. Those who found algebraic expressions for t_1 and t_2 could find $t_1 + t_2$ but had difficulties with the product. Many candidates found an expression in x, set $y = 0$ or $\dot{x} = 0$ then stated the result without any explanation of how this related to t_1 and t_2.

(b) and (c) In better responses, candidates who attempted these parts linked them to lead-in information and were careful with the algebra. Many candidates who did not attempt part (a) nonetheless gained full marks for these two parts.

(d) Candidates who indicated $r = OP + PN$ were the most likely to gain full marks on this question. Simply writing $Vt_1 \cos\theta + Vt_2 \cos\theta$ without explanation of what this stood for was common. Finding the range r required explanation of how this related to $\cos\alpha$ and $\cos\beta$. A number of responses treated t_1 as if it was the x coordinate at P. Many responses failed to find w.

(e) Very few candidates realised that $\tan\phi$ was the slope of the tangent at L meaning that the derivative was required. Those who found the derivative in terms of t did not then know how to proceed. The most successful candidates were those who found the derivative in terms of x and substituted $x = h\cot\alpha$.

(f) Candidates failed to show key steps in their solutions. The most common error was to use the incorrect identity $\cot\beta - \cot\alpha = \dfrac{1}{\tan\beta - \tan\alpha}$.

Mathematics Extension 1

2008 HSC Examination Mapping Grid

Question	Marks	Content	Syllabus outcomes
1 (a)	2	16.2	PE3
1 (b)	2	15.5	HE4
1 (c)	2	15.5	HE4
1 (d)	2	17.1	HE3
1 (e)	2	13.6	HE6
1 (f)	2	9.1, 12.2	HE7
2 (a)	3	11.5	HE6
2 (b)	3	14.3	HE5
2 (c)	3	16.3	PE3
2 (d)	3	16.4	HE7
3 (a) (i)	1	1.4, 4.1	PE2, PE3
3 (a) (ii)	3	1.4, 4.1	PE2, PE3
3 (b)	3	7.4	HE2
3 (c) (i)	2	14.1, 15.5	HE3, HE4, HE5
3 (c) (ii)	1	1.1	HE2, HE7
3 (c) (iii)	2	5.2, 13.1	HE3, HE7
4 (a) (i)	2	14.2	HE3, HE7
4 (a) (ii)	3	14.2	HE3, HE7
4 (b) (i)	1	18.1	PE3
4 (b) (ii)	1	18.1	PE3
4 (c) (i)	2	9.6	PE3
4 (c) (ii)	1	9.6	PE3
4 (c) (iii)	2	2.9, 2.10	PE3
5 (a) (i)	2	9.1, 15.1	HE4
5 (a) (ii)	3	9.1, 15.1	HE4
5 (a) (iii)	1	9.1, 15.1	HE4
5 (b)	3	14.4	HE3
5 (c)	3	2.8, 2.9	HE2
6 (a) (i)	1	5.6	PE6
6 (a) (ii)	3	5.6	PE2
6 (b)	3	5.2, 13.1	HE7
6 (c) (i)	2	17.1	HE3
6 (c) (ii)	3	17.3	HE3
7 (a)	2	14.3, 16.3	PE3, HE3
7 (b)	2	14.3	HE3
7 (c)	1	14.3	HE3
7 (d)	2	5.1, 9.1, 14.3	HE3
7 (e)	3	14.3	HE3
7 (f)	2	14.3	HE3

Question 1 (a)

Outcomes assessed: PE3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Shows some understanding of the remainder theorem	1

Question 1 (b)

Outcomes assessed: HE4

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Answers of the form $\dfrac{A}{\sqrt{1-Bx^2}}$	1

Question 1 (c)

Outcomes assessed: HE4

MARKING GUIDELINES

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

Question 1 (d)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Expression involving correct binomial coefficient or equivalent merit	1

Question 1 (e)

Outcomes assessed: HE6

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Makes some progress towards finding the correct primitive	1

Question 1 (f)

Outcomes assessed: HE7

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Recognises that $(x-3)(5-x)$ must be positive	1

Question 2 (a)

Outcomes assessed: HE6

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Makes the given substitution and obtains correct primitive	2
• Attempts the given substitution	1

Question 2 (b)

Outcomes assessed: HE5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Shows $v^2 = x^2 + 8x - 9$ or equivalent progress	2
• Shows $\frac{1}{2}v^2 = \frac{x^2}{2} + 4x + c$	1

Question 2 (c)

Outcomes assessed: PE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Makes significant progress	2
• Shows some understanding of the relationship between coefficients and zeros of polynomials	1

Question 2 (d)

Outcomes assessed: HE7

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Computes $f'(x)$ and shows some understanding of Newton's method	2
• Computes $f'(x)$ or equivalent merit	1

Question 3 (a) (i)

Outcomes assessed: PE2, PE3

MARKING GUIDELINES

Criteria	Marks
• Correct sketch	1

Question 3 (a) (ii)

Outcomes assessed: PE2, PE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Finds at least one correct end point	2
• Adds graph of $y = \lvert x - 3 \rvert$ to sketch in part (i)	1

Question 3 (b)

Outcomes assessed: HE2

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Establishes the inductive step or equivalent merit	2
• Establishes the initial case	1

Question 3 (c) (i)

Outcomes assessed: HE3, HE4, HE5

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Writes $\tan\theta = \dfrac{x}{\ell}$ or $\theta = \tan^{-1}\dfrac{x}{\ell}$	1

Question 3 (c) (ii)

Outcomes assessed: HE2, HE7

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 3 (c) (iii)

Outcomes assessed: HE3, HE7

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Shows $x^2 = 3\ell^2$	1

Question 4 (a) (i)

Outcomes assessed: HE3, HE7

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Shows that the given equation satisfies the initial condition or equivalent merit	1

Question 4 (a) (ii)

Outcomes assessed: HE3, HE7

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Finds the appropriate value of t	2
• Finds k or equivalent merit	1

Question 4 (b) (i)

Outcomes assessed: PE3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 4 (b) (ii)

Outcomes assessed: PE3

MARKING GUIDELINES

Criteria	Marks
• Correct answer	1

Question 4 (c) (i)

Outcomes assessed: PE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Finds gradient of QO or equivalent merit	1

Question 4 (c) (ii)

Outcomes assessed: PE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 4 (c) (iii)

Outcomes assessed: PE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Recognises the significance of the fact that $\angle QLP = \angle QKP$	1

Question 5 (a) (i)

Outcomes assessed: HE4

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Attempts to reflect their graph of $y = f(x)$ in the line $y = x$	1

Question 5 (a) (ii)

Outcomes assessed: HE4

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Shows $y = 1 \pm \sqrt{1 - 2x}$	2
• Obtains $x = y - \frac{1}{2}y^2$ or equivalent merit	1

Question 5 (a) (iii)

Outcomes assessed: HE4

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 5 (b)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Finds amplitude or period or equivalent merit	2
• States $nA = 2$ or $n^2A = 6$ or equivalent merit	1

Question 5 (c)

Outcomes assessed: HE2

MARKING GUIDELINES

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

Question 6 (a) (i)

Outcomes assessed: PE6

MARKING GUIDELINES

Criteria	Marks
• Correct diagram	1

Question 6 (a) (ii)

Outcomes assessed: PE2

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Obtains $AO = h\cot 23°$ and $BO = h\cot 32°$ and attempts to apply cosine rule	2
• Obtains $AO = h\cot 23°$ or equivalent merit	1

Question 6 (b)

Outcomes assessed: HE7

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Obtains $\sin\theta = 0$ and $\cos\theta = -1$ and $\cos\theta = \frac{1}{2}$	2
• Obtains expression in terms of $\sin\theta$ and $\cos\theta$ only	1

Question 6 (c) (i)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Correctly applies the binomial expression to $(1+x)^{p+q}$	1

Question 6 (c) (ii)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Expands both $(1+x)^p$ and $\left(1+\frac{1}{x}\right)^q$ and attempts to multiply	2
• Expands both $(1+x)^p$ and $\left(1+\frac{1}{x}\right)^q$ using the binomial expansion	1

Question 7 (a)

Outcomes assessed: PE3, HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Identifies t_1 and t_2 with the zeros of $t^2 - \frac{2V\sin\theta t}{g} + \frac{2h}{g}$	1

Question 7 (b)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Substitutes the given expressions for tan α and tan β	1

Question 7 (c)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	1

Question 7 (d)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Shows the given result for r or w	1

Question 7 (e)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	3
• Attempts to eliminate t_1	2
• Shows $\tan\phi = \tan\theta - \dfrac{gt_1}{V\cos\theta}$	1

Question 7 (f)

Outcomes assessed: HE3

MARKING GUIDELINES

Criteria	Marks
• Correct solution	2
• Shows $\dfrac{w}{\tan\theta} = \dfrac{h}{\tan\alpha\ \tan\beta}$	1