2010 HSC Mathematics Extension 2
Marking Guidelines

Question 1 (a)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correct solution</td>
<td>2</td>
</tr>
<tr>
<td>• Shows evidence of implicitly or explicitly substituting $u = 1 + 3x^2$</td>
<td>1</td>
</tr>
</tbody>
</table>

Question 1 (b)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correct solution</td>
<td>3</td>
</tr>
<tr>
<td>• Obtains correct primitive</td>
<td>2</td>
</tr>
<tr>
<td>• Recognises $\tan x = \frac{\sin x}{\cos x}$</td>
<td>1</td>
</tr>
</tbody>
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Question 1 (c)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
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<tbody>
<tr>
<td>• Correct solution</td>
<td>3</td>
</tr>
<tr>
<td>• Correct partial fraction decomposition, or equivalent merit</td>
<td>2</td>
</tr>
<tr>
<td>• Attempts partial fraction decomposition</td>
<td>1</td>
</tr>
</tbody>
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### Question 1 (d)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct solution</td>
<td>4</td>
</tr>
<tr>
<td>Obtains correct primitive, or equivalent merit</td>
<td>3</td>
</tr>
<tr>
<td>Obtains ( \int \frac{2}{(1 + t)^2} dt ), or equivalent merit</td>
<td>2</td>
</tr>
<tr>
<td>Correctly substitutes for ( dx ) in terms of ( t ), or for sin ( x ) in terms of ( t ), or equivalent merit</td>
<td>1</td>
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### Question 1 (e)

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>Correct solution</td>
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</tr>
<tr>
<td>Makes substantial progress</td>
<td>2</td>
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<tr>
<td>Makes an appropriate substitution</td>
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### Question 2 (a) (i)

<table>
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<th>Criteria</th>
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<tbody>
<tr>
<td>Correct answer</td>
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### Question 2 (a) (ii)

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<tr>
<td>Correct answer</td>
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### Question 2 (a) (iii)

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</thead>
<tbody>
<tr>
<td>Correct solution</td>
<td>2</td>
</tr>
<tr>
<td>Attempts to multiply by ( \frac{5 + i}{5 + i} )</td>
<td>1</td>
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### Question 2 (b) (i)

<table>
<thead>
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<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>Correct solution</td>
<td>2</td>
</tr>
<tr>
<td>Correct modulus OR correct argument</td>
<td>1</td>
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### Question 2 (b) (ii)

<table>
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<th>Criteria</th>
<th>Marks</th>
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<tbody>
<tr>
<td>Correct solution</td>
<td>2</td>
</tr>
<tr>
<td>Obtains $2^6\left(\cos 7\pi + i\sin 7\pi\right)$, or equivalent merit</td>
<td>1</td>
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### Question 2 (c)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
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<tbody>
<tr>
<td>Correct sketch</td>
<td>2</td>
</tr>
<tr>
<td>Correctly sketches one of the regions</td>
<td>1</td>
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### Question 2 (d) (i)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
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<tbody>
<tr>
<td>Shows that $OA = OB = 1$</td>
<td>1</td>
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### Question 2 (d) (ii)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
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<tbody>
<tr>
<td>Correct solution</td>
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### Question 2 (d) (iii)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>Correct proof</td>
<td>2</td>
</tr>
<tr>
<td>Makes some progress</td>
<td>1</td>
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### Question 2 (d) (iv)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
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<tbody>
<tr>
<td>Correct deduction</td>
<td>1</td>
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</table>
### Question 3 (a) (i)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct sketch</td>
<td>1</td>
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### Question 3 (a) (ii)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>Correct sketch</td>
<td>2</td>
</tr>
<tr>
<td>Identifies the vertical asymptotes, or equivalent merit</td>
<td>1</td>
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### Question 3 (b)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
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<tbody>
<tr>
<td>Correct solution</td>
<td>4</td>
</tr>
<tr>
<td>Obtains a correct primitive</td>
<td>3</td>
</tr>
<tr>
<td>Obtains a correct integral</td>
<td>2</td>
</tr>
<tr>
<td>Makes progress towards obtaining a correct integral</td>
<td>1</td>
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### Question 3 (c)

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<thead>
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<th>Criteria</th>
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</thead>
<tbody>
<tr>
<td>Correct solution</td>
<td>2</td>
</tr>
<tr>
<td>Observes that $P(1 - P) = 0.24$ (where $P =$ probability heads, or tails)</td>
<td>1</td>
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### Question 3 (d) (i)

<table>
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<tr>
<th>Criteria</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>Correct solution</td>
<td>2</td>
</tr>
<tr>
<td>Finds the gradient of QA correctly, or equivalent merit</td>
<td>1</td>
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### Question 3 (d) (ii)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answer</td>
<td>1</td>
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### Question 3 (d) (iii)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correct solution</td>
<td>2</td>
</tr>
<tr>
<td>• Attempts to solve simultaneously the equations for $\ell_1$ and $\ell_2$, or equivalent merit</td>
<td>1</td>
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### Question 3 (d) (iv)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>• Correct description (i.e. the top branch of the hyperbola)</td>
<td>1</td>
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### Question 4 (a) (i)

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<tr>
<th>Criteria</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>• Correct solution</td>
<td>2</td>
</tr>
<tr>
<td>• Attempts to differentiate implicitly</td>
<td>1</td>
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### Question 4 (a) (ii)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>• Correct sketch vertical at (0, 1) and horizontal at (1, 0)</td>
<td>2</td>
</tr>
<tr>
<td>• Sketch showing some relevant features</td>
<td>1</td>
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### Question 4 (a) (iii)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>• Correct sketch</td>
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### Question 4 (b) (i)

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<th>Criteria</th>
<th>Marks</th>
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<tbody>
<tr>
<td>• Correct solution</td>
<td>3</td>
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<tr>
<td>• Resolves forces, and attempts to eliminate $N$</td>
<td>2</td>
</tr>
<tr>
<td>• Resolves forces horizontally or vertically, or equivalent merit</td>
<td>1</td>
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### Question 4 (b) (ii)

<table>
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<tbody>
<tr>
<td>• Correct solution</td>
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Question 4 (c)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
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<tbody>
<tr>
<td>• Correct proof</td>
<td>3</td>
</tr>
<tr>
<td>• Deduces that a solution exists when ( k \geq 4 ), or equivalent merit</td>
<td>2</td>
</tr>
<tr>
<td>• Obtains a relevant quadratic equation in ( a ), or equivalent merit</td>
<td>1</td>
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Question 4 (d) (i)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correct answer</td>
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Question 4 (d) (ii)

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<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correct solution</td>
<td>2</td>
</tr>
<tr>
<td>• Obtains ( \frac{12}{4} \times \frac{8}{4} ), or equivalent merit</td>
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Question 5 (a) (i)

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<th>Criteria</th>
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<td>• Correct answer</td>
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Question 5 (a) (ii)

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<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correct solution</td>
<td>1</td>
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</table>

Question 5 (a) (iii)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correct equation</td>
<td>2</td>
</tr>
<tr>
<td>• Finds the gradient of the tangent, or equivalent merit</td>
<td>1</td>
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</table>
### Question 5 (a) (iv)

<table>
<thead>
<tr>
<th>Criteria</th>
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</thead>
<tbody>
<tr>
<td>Correct solution</td>
<td>2</td>
</tr>
<tr>
<td>Finds where one of the tangents cuts the $x$ axis, or equivalent merit</td>
<td>1</td>
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### Question 5 (b)

<table>
<thead>
<tr>
<th>Criteria</th>
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<tbody>
<tr>
<td>Correct solution</td>
<td>2</td>
</tr>
<tr>
<td>Attempts to differentiate $\ln\left(\frac{y}{1-y}\right)$, or attempts to use partial fractions on $\frac{1}{y(1-y)}$, or equivalent merit</td>
<td>1</td>
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### Question 5 (c) (i)

<table>
<thead>
<tr>
<th>Criteria</th>
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<tbody>
<tr>
<td>Correct solution</td>
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### Question 5 (c) (ii)

<table>
<thead>
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<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>Correct solution</td>
<td>3</td>
</tr>
<tr>
<td>Attempts to solve a correct equation for $y$</td>
<td>2</td>
</tr>
<tr>
<td>Obtains $\ln\left(\frac{y}{1-y}\right) = ax + c$</td>
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### Question 5 (c) (iii)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
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<tbody>
<tr>
<td>Correct answer</td>
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### Question 5 (c) (iv)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
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<tbody>
<tr>
<td>Correct solution $\left(\text{ie inflection at } y = \frac{1}{2} \text{ or, graph is steepest when } y = \frac{1}{2}\right)$</td>
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</table>
Question 5 (c) (v)

<table>
<thead>
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<th>Criteria</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>Correct sketch</td>
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Question 6 (a) (i)

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<tbody>
<tr>
<td>Correct solution</td>
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</tr>
<tr>
<td>Attempts to use appropriate similar triangles, or equivalent merit</td>
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Question 6 (a) (ii)

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<tbody>
<tr>
<td>Correct solution</td>
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<tr>
<td>Obtains volume $\int_0^h \left( a - \frac{a - b}{h} \right)^2 dx$, or equivalent merit</td>
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Question 6 (b)

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<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
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<tbody>
<tr>
<td>Correct proof</td>
<td>3</td>
</tr>
<tr>
<td>Makes substantial progress</td>
<td>2</td>
</tr>
<tr>
<td>Checks that the formula holds for $n = 0$ and $n = 1$, or equivalent merit</td>
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Question 6 (c) (i)

<table>
<thead>
<tr>
<th>Criteria</th>
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<tr>
<td>Correct expansion</td>
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Question 6 (c) (ii)

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<tbody>
<tr>
<td>Correct solution</td>
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</tr>
<tr>
<td>Correctly equates imaginary parts of the two expansions, or equivalent merit</td>
<td>2</td>
</tr>
<tr>
<td>Correct use of de Moivre’s theorem, or equivalent merit</td>
<td>1</td>
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</table>
Question 6 (c) (iii)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>Correct deduction</td>
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Question 6 (c) (iv)

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Question 6 (c) (v)

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Question 6 (c) (vi)

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Question 7 (a) (i)

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<th>Criteria</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>Correct proof</td>
<td>2</td>
</tr>
<tr>
<td>Identifies any pair of equal angles</td>
<td>1</td>
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Question 7 (a) (ii)

<table>
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<tr>
<th>Criteria</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>Correct solution</td>
<td>2</td>
</tr>
<tr>
<td>Obtains a relevant ratio, or equivalent merit</td>
<td>1</td>
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Question 7 (a) (iii)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
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<tbody>
<tr>
<td>Correct solution</td>
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</tr>
<tr>
<td>Obtains lengths of sides and diagonals of an appropriate cyclic quadrilateral</td>
<td>1</td>
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</table>
Question 7 (b)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correct graphs, or equivalent merit</td>
<td>1</td>
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Question 7 (c) (i)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correct solution</td>
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Question 7 (c) (ii)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correct solution</td>
<td>1</td>
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Question 7 (c) (iii)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correct graph and correct explanation</td>
<td>2</td>
</tr>
<tr>
<td>• Finds that the curve $y = P(x)$ has a minimum at $(1, 0)$ and a maximum at $(0, 1)$, or recognises that $P(x) \to \infty$ as $x \to \infty$, and $P(x) \to -\infty$ as $x \to -\infty$, or equivalent merit</td>
<td>1</td>
</tr>
</tbody>
</table>

Question 7 (c) (iv)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correct solution</td>
<td>2</td>
</tr>
<tr>
<td>• Shows that $P\left(-\frac{1}{2}\right) \geq 0$, or equivalent merit</td>
<td>1</td>
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Question 7 (c) (v)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correct solution</td>
<td>2</td>
</tr>
<tr>
<td>• Recognises that the zeros are $1, 1, \alpha, \beta$, or equivalent merit</td>
<td>1</td>
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</tbody>
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### Question 8 (a)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct solution</td>
<td>2</td>
</tr>
<tr>
<td>Uses integration by parts appropriately</td>
<td>1</td>
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</tbody>
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### Question 8 (b)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct solution</td>
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### Question 8 (c)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct solution</td>
<td>3</td>
</tr>
<tr>
<td>Makes substantial progress</td>
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<td>Uses integration by parts to introduce a factor of $x^2$ into the integral</td>
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### Question 8 (d)

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### Question 8 (e)

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<td>Shows that $\sum_{k=1}^{\infty} \frac{1}{k^2} = 2 \left( \frac{B_0}{A_0} - \frac{B_n}{A_n} \right)$, or correctly calculates $\frac{B_0}{A_0}$, or equivalent merit</td>
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### Question 8 (f)

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### Question 8 (g)

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### Question 8 (h)

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<td>Substitutes $x = \frac{\pi}{2} \sin t$ correctly</td>
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### Question 8 (i)

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### Question 8 (j)

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