A-level

Mathematics

MFP2 – Further Pure 2

Mark scheme

6360

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Version: 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Key to mark scheme abbreviations

M	mark is for method
m or dM	mark is dependent on one or more M marks and is for method
A	mark is dependent on M or m marks and is for accuracy
B	mark is independent of M or m marks and is for method and accuracy
E	mark is for explanation
√or ft or F	follow through from previous incorrect result
CAO	correct answer only
CSO	correct solution only
AWFW	anything which falls within
AWRT	anything which rounds to
ACF	any correct form
AG	answer given
SC	special case
OE	or equivalent
A2,1	2 or 1 (or 0) accuracy marks
–*x* EE	deduct *x* marks for each error
NMS	no method shown
PI	possibly implied
SCA	substantially correct approach
c	candidate
sf	significant figure(s)
dp	decimal place(s)

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

Q1	Solution	Mark	Total	Comment
(a)	$\mathrm{f}(r)-\mathrm{f}(r+1)=\frac{1}{4r-1}-\frac{1}{4(r+1)-1}$	**M1**		**or** $\frac{1}{4r-1}-\frac{1}{4r+3}$
	$=\frac{4}{(4r-1)(4r+3)}$	**A1**	2	
(b)	$\frac{1}{3}-\frac{1}{7}+\frac{1}{7}-\frac{1}{11}+\ldots$ **OE** **or** $\mathrm{f}(1)-\mathrm{f}(2)+\mathrm{f}(2)-\mathrm{f}(3)+\ldots$	**M1**		Clear attempt to use **method of differences** possibly with one error **PI** by first **A1**
	$\sum_{r=1}^{50}\left[\mathrm{f}(r)-\mathrm{f}(r+1)\right]=\mathrm{f}(1)-\mathrm{f}(51)$			
	$=\frac{1}{3}-\frac{1}{203}$	**A1**		
	$\sum_{r=1}^{50}\frac{1}{(4r-1)(4r+3)}=\frac{1}{4}\left(\frac{1}{3}-\frac{1}{203}\right)$	**m1**		$"their"\frac{1}{4}\times"their"\left(\frac{1}{3}-\frac{1}{203}\right)$
	$=\frac{50}{609}$	**A1**	4	
	Total		6	
(b)	Allow recovery for full marks in part **(b)** even if errors seen in part **(a)**			

Q2	Solution	Mark	Total	Comment
(a)(i)	$1-2\text{i}$	B1	1	
(ii)	$(\alpha\beta = 1+4=)\quad 5$	B1	1	
(b)	$\sum\alpha\beta = \frac{17}{3}$	B1		**PI** by next line
	$\alpha\gamma+\beta\gamma+\text{"}their\text{"}5 = \text{"}their\text{"}\frac{17}{3}$	M1		**FT** "their" $\alpha\beta$ and $\sum\alpha\beta$ values
	$\Rightarrow \gamma = \frac{1}{3}$	A1	3	**Alternative** $z^3+\frac{p}{3}z^2+\frac{17}{3}z+\frac{q}{3}$ quadratic factor z^2-2z+5 **B1** $(z^2-2z+5)(z-\gamma)$ comparing coefficient of z: $5+2\gamma=\frac{17}{3}$ **M1** $\Rightarrow \gamma=\frac{1}{3}$ **A1 (3)**
(c)	$\alpha+\beta+\gamma=\frac{-p}{3}$, $\alpha\beta\gamma=\frac{-q}{3}$	M1		Either of these expressions correct **PI** by correct p or q
	$p=-7$	A1		
	$q=-5$	A1	3	**Alternative** comparing coefficients either $-5\gamma=\frac{q}{3}$ or $-\gamma-2=\frac{p}{3}$ **M1** $p=-7$ **A1;** $q=-5$ **A1 (3)**
	Total		8	
(b)	Allow **M1** for $5+2\gamma=-\frac{17}{3}$ if $\sum\alpha\beta$ not seen			
(c)	**Example :** $\alpha+\beta+\gamma=-p$ **;** $\alpha+\beta+\gamma=2+\frac{1}{3}=\frac{7}{3}$ $\Rightarrow p=-7$ Award **M1 A1** assuming first statement was meant as candidate's "reminder" for signs but "wiggly underline" incorrect statement **Example :** $\gamma=\frac{4}{3}$ $\alpha+\beta+\gamma=\frac{10}{3}$ **;** $\Rightarrow p=-10$ Award **M1 (implied) A0** **Alternative:** substituting z = 1+2i or 1–2i leading to correct simultaneous equations $3p-q+16=0$ $4p+28=0$ **M1** then $p=-7$ **A1;** $q=-5$ **A1**			

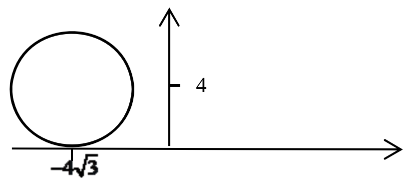
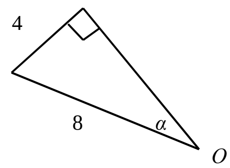
Q3	Solution	Mark	Total	Comment
(a)	$\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{2x}{(1-x^2)}$	**B1**		
	$1+\left(\dfrac{\mathrm{d}y}{\mathrm{d}x}\right)^2=1+\dfrac{(2x)^2}{(1-x^2)^2}$	**M1**		FT their $\dfrac{\mathrm{d}y}{\mathrm{d}x}$
	$\dfrac{1-2x^2+x^4+4x^2}{(1-x^2)^2}=\dfrac{(1+x^2)^2}{(1-x^2)^2}$	**m1**		Allow **m1** if sign error in $\dfrac{\mathrm{d}y}{\mathrm{d}x}$
	$s=\int\sqrt{1+\left(\frac{\mathrm{d}y}{\mathrm{d}x}\right)^2}\,\mathrm{d}x$ $s=\int_0^{\frac{3}{4}}\left(\dfrac{1+x^2}{1-x^2}\right)\mathrm{d}x$	**A1cso**	**4**	**AG** must have dx and limits on final line
(b)	$\dfrac{1+x^2}{1-x^2}=\dfrac{A}{1-x^2}+B$	**M1**		and attempt to find constants $B\neq 0$
	$\dfrac{1+x^2}{1-x^2}=\dfrac{2}{1-x^2}-1$	**A1**		
	$\left(\dfrac{A}{2}\ln\left(\dfrac{1+x}{1-x}\right)\text{ or } A\tanh^{-1}x\right)+Bx$	**m1**		**FT** integral of their $\dfrac{A}{1-x^2}+B$
	$\ln\left(\dfrac{1+x}{1-x}\right)-x$	**A1**		**or** $2\tanh^{-1}x-x$ correct
	$\ln\left(\dfrac{1+\frac{3}{4}}{1-\frac{3}{4}}\right)-\dfrac{3}{4}$ **OE**	**A1**		**PI** by next **A1** **or** $(s=)2\tanh^{-1}\left(\dfrac{3}{4}\right)-\dfrac{3}{4}$
	$-\dfrac{3}{4}+\ln 7$	**A1**	**6**	or $(s)=\ln 7-\dfrac{3}{4}$
	Alternative $\dfrac{1+x^2}{1-x^2}=\dfrac{C}{1+x}+\dfrac{D}{1-x}+E$	**(M1)**		and attempt to find constants $E\neq 0$
	$\dfrac{1+x^2}{1-x^2}=\dfrac{1}{1+x}+\dfrac{1}{1-x}-1$	**(A1)**		
	$C\ln(1+x)-D\ln(1-x)+Ex$	**(m1)**		**FT** integral of their $\dfrac{C}{1+x}+\dfrac{D}{1-x}+E$
	$=\ln(1+x)-\ln(1-x)-x$	**(A1)**		correct
	$(s=)\quad\ln\dfrac{7}{4}-\ln\dfrac{1}{4}-\dfrac{3}{4}$ **OE**	**(A1)**		correct unsimplified
	$(s)=\ln 7-\dfrac{3}{4}$	**(A1)**	**(6)**	
	Total		**10**	
(a)	Condone omission of brackets in final line or poor use of brackets if recovered for **A1cso**			
(b)	If **M1** is not earned, award **SC B1** for sight of $\int\dfrac{1}{1-x^2}\,\mathrm{d}x=\dfrac{1}{2}\ln\left(\dfrac{1+x}{1-x}\right)$ or $\tanh^{-1}x$ or **SC B1** for sight of $\int\dfrac{p}{1+x}+\dfrac{q}{1-x}\mathrm{d}x=p\ln(1+x)-q\ln(1-x)$			

Q4	Solution	Mark	Total	Comment
(a)	$\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right)\quad \frac{1}{1+\left(\sqrt{3x}\right)^2}$	M1		$\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{1}{1+3x}$
	$\times\frac{1}{2}\times\sqrt{3}\,x^{-\frac{1}{2}}$ **OE**	A1	2	may have $\frac{3}{\sqrt{3}}$ instead of $\sqrt{3}$ For guidance $\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{\sqrt{3}}{2(1+3x)\sqrt{x}}$
(b)	$\left(\int=\right)\quad k\tan^{-1}\sqrt{3x}$	M1		
	$\left(\int\quad=\right)\quad \frac{2}{\sqrt{3}}\tan^{-1}\sqrt{3x}$	A1		
	$k\left(\frac{\pi}{3}-\frac{\pi}{4}\right)$	m1		**or** $k\frac{\pi}{12}$ **PI** by correct answer
	$=\frac{\sqrt{3}\pi}{18}$	A1	4	
	Total		**6**	

(a) **Alternative 1** $\sec^2 y\frac{\mathrm{d}y}{\mathrm{d}x}=\ k\,x^{-\frac{1}{2}}$ **M1** leading to correct $\frac{\mathrm{d}y}{\mathrm{d}x}$ in terms of x **A1**

Alternative 2 $x=A\tan^2 y \Rightarrow \frac{\mathrm{d}x}{\mathrm{d}y}=k\sec^2 y\tan y$ **M1** leading to correct $\frac{\mathrm{d}y}{\mathrm{d}x}$ in terms of x **A1**

(b) If a substitution such as $u=\sqrt{x}$ is used giving $\int\frac{2}{1+3u^2}\,\mathrm{d}u$ then **M1** is still only earned for $k\tan^{-1}\sqrt{3}\,u$ and **A1** for $\frac{2}{\sqrt{3}}\tan^{-1}\sqrt{3}\,u$ and **m1 A1** as above

Q5	Solution	Mark	Total	Comment
(a)	$\left(-4\sqrt{3}\right)^2+4^2 \quad (=48+16)$	**M1**		**PI** by correct answer
	(Modulus =) 8	**A1**	**2**	
(b)(i)	circle	**M1**		condone freehand circle
	centre at $-4\sqrt{3}+4\mathrm{i}$	**A1**		
	circle touching negative real axis and not meeting imaginary axis	**A1**	**3**	
(ii)	Right angled triangle hyp = 8 & radius = 4 & $\alpha=\dfrac{\pi}{6}$ as in diagram	**M1**		 May consider the triangle with one side on real axis but only earns **M1** when angle doubled to $\dfrac{\pi}{3}$
	$\arg w=\dfrac{2\pi}{3}$	**A1**	**2**	must be exact but allow $\dfrac{4\pi}{6}$ etc
(c)	$r=(8)^{\frac{1}{3}} \quad (=2)$	**B1F**		$r=(\text{modulus from } \mathbf{(a)})^{\frac{1}{3}}$
	$\arg(-4\sqrt{3}+4i)=\dfrac{5\pi}{6}$	**B1**		
	Use of de Moivre "their" arg/3	**M1**		
	$\theta=\dfrac{5\pi}{18}$, $\dfrac{17\pi}{18}$, $\dfrac{-7\pi}{18}$	**A1**		3 correct values of θ $\mod 2\pi$ eg third angle $\dfrac{29\pi}{18}$
	Roots are $2\mathrm{e}^{\mathrm{i}\frac{5\pi}{18}}, 2\mathrm{e}^{\mathrm{i}\frac{17\pi}{18}}, 2\mathrm{e}^{\mathrm{i}\left(\frac{-7\pi}{18}\right)}$	**A1**	**5**	must be in exactly this form for final mark final root may be written as $2\mathrm{e}^{-\mathrm{i}\frac{7\pi}{18}}$ etc
	Total		**12**	
(a)	**NMS (**Modulus =) 8 earns **M1**(implied) **A1**			
(b)(i)	The two **A1** marks are independent; first **A1 PI** by $-4\sqrt{3}$ marked on Re(z) axis & 4 marked on Im(z) axis; condone centre stated as ($-4\sqrt{3}$, 4) for first **A1 but** withhold **first A1** if point of contact labelled as anything other than $-4\sqrt{3}$ second **A1** is awarded if clear intention to touch the negative real axis but radius = 4 need not be marked			
(ii)	Condone $\arg w \ldots \dfrac{2\pi}{3}$.			
(c)	**Example**: $r=2$; $\theta=\dfrac{2k\pi}{3}+\dfrac{5\pi}{18}$ $k=0,1,-1$ scores **B1F, B1, M1, A1, A0**			

Q6	Solution	Mark	Total	Comment
(a)	$y=\frac{1}{2}\left(e^{x}-e^{-x}\right)$			allow $e^{2x}-2ye^{x}=1$ for **M1** if attempting to complete square
	$\Rightarrow e^{2x}-2ye^{x}-1\quad(=0)$	M1		terms all on one side
	$\left(e^{x}=\right)\quad\frac{2y\pm\sqrt{4y^{2}+4}}{2}$	A1		or $e^{x}-y=\pm\sqrt{y^{2}+1}$ after completing square
	$e^{x}>0$ so reject negative root	E1		any correct explanation for rejection
	$e^{x}=y+\sqrt{y^{2}+1}\Rightarrow x=\ln\left(y+\sqrt{y^{2}+1}\right)$	A1	4	**AG** must earn previous **A1**
(b)(i)	$\frac{dy}{dx}=6\times2\cosh x\sinh x$ (**not** 6 sinh2x)	B1		directly or via $3\cosh2x+3$
	$+5\cosh x$	B1		
	$\cosh x=0$ gives no solution (only stationary point when)	E1		Not simply cancelling $\cosh x$
	$\sinh x=-\frac{5}{12}$	M1		**FT "**their" $\sinh x$ from equation of form $A\cosh x\sinh x+B\cosh x$
	$x=\ln\left(-\frac{5}{12}+\sqrt{1+\frac{25}{144}}\right)$			**or M1** for using exponentials obtaining $e^{x}=\frac{2}{3}$ or $-\frac{3}{2}$ OE
	$=\ln\left(\frac{2}{3}\right)$	A1	5	accept $\ln\left(\frac{8}{12}\right)$ **OE**
(ii)	$Area=\int_{0}^{\cosh^{-1}2}\left(6\cosh^{2}x+5\sinh x\right)dx$			
	$6\cosh^{2}x=3+3\cosh2x$	B1		or $6\cosh^{2}x=\frac{3}{2}\left(e^{2x}+2+e^{-2x}\right)$
	$Ax+B\sinh2x$ or $Cx+D(e^{2x}-e^{-2x})$	M1		correct **FT** "their" $\int 6\cosh^{2}x\,dx$
	$3x+\frac{3}{2}\sinh2x+5\cosh x$	A1		integration all correct (may be in e^{x} form)
	$3\cosh^{-1}2+\frac{3}{2}\sinh(2\cosh^{-1}2)+10\quad-5$	m1		$F(\cosh^{-1}2)-F(0)$ correct substitution of limits into **their** expression
	$\left(Area=\right)3\cosh^{-1}2+6\sqrt{3}+5$	A1	5	
	Total		14	

(a) May find $\ln\left(y\pm\sqrt{y^{2}+1}\right)$ and reason about not having negative ln for **E1**

Alternative: $y=\sinh x\Rightarrow1+y^{2}=\cosh^{2}x$ **M1;** Rejecting minus sign since $\cosh x>0$ **E1**

$\cosh x=\sqrt{1+y^{2}}$; $y+\sqrt{1+y^{2}}=\frac{1}{2}\left(e^{x}-e^{-x}+e^{x}+e^{-x}\right)=e^{x}$ **A1** $\Rightarrow x=\ln\left(y+\sqrt{y^{2}+1}\right)$ **A1**

(b)(i) If using double angle formula incorrectly, eg $6\cosh^{2}x=3\cosh2x-3\Rightarrow\frac{dy}{dx}=6\sinh2x=12\sinh x\cosh x$ then award **B0** for this term but allow final **A1** although **FIW**, since this will be penalised heavily in part **(b)(ii)**

(ii) May use $\cosh^{-1}2=\ln\left(2+\sqrt{3}\right)$ when finding $F(\cosh^{-1}2)$ and **m1** may be implied by correct final answer

Q7	Solution	Mark	Total	Comment
	$n=1$: LHS $=1+p$; RHS $=1+p$ Therefore result is true when $n=1$	**B1**		
	Assume inequality is true for $n=k$ (*)			
	Multiply both sides by $1+p$ $(1+p)^{k+1} \ldots (1+kp)(1+p)$ Inequality only valid since multiplication by positive number because $1+p \ldots 0$	**E1**		and stating $1+p \ldots 0$ before multiplying both sides by $1+p$ or justifying why inequality remains $\ldots$
	Considering $(1+kp)(1+p)$	**M1**		and attempt to multiply out
	RHS $=1+kp+p+kp^2$	**A1**		
	RHS $\ldots 1+kp+p$			must have $\ldots$
	$\Rightarrow (1+p)^{k+1} \ldots 1+(k+1)p$	**A1**		correct algebra and inequalities throughout
	Hence inequality is true when $n=k+1$ (**) but true for $n=1$ so true for $n=2, 3, \ldots$ by induction (***) (or true for all integers $n \ldots 1$ (***))	**E1**	**6**	must have (*), (**) and (***) and must have earned previous **B1, M1, A1, A1** marks
	Total		**6**	
	Statement "true for $n=1$ may appear in conclusion such as "true for $n \ldots 1$" allowing **B1** to be earned May write $(1+p)^{k+1}=(1+p)^k(1+p) \ldots (1+kp)(1+p)$ with justification for $\ldots$ for first **E1** May earn final **E1** even if first **E1** has not been earned, provided other **4 marks** are scored. If ***final*** statement is "true for all $n \ldots 1$" do not award final **E1**			

Q8	Solution	Mark	Total	Comment
(a)	$\left(\cos\theta + \mathrm{i}\sin\theta\right)^4 = \cos 4\theta + \mathrm{i}\sin 4\theta$	B1		
	$\left(\cos\theta - \mathrm{i}\sin\theta\right)^4 = \cos 4\theta - \mathrm{i}\sin 4\theta$ $\left(\mathrm{c}+\mathrm{is}\right)^4 + \left(\mathrm{c}-\mathrm{is}\right)^4 = 2\cos 4\theta$	M1		
	Divide throughout by $\cos^4\theta$ $\left(1+\mathrm{i}\tan\theta\right)^4 + \left(1-\mathrm{i}\tan\theta\right)^4 = \dfrac{2\cos 4\theta}{\cos^4\theta}$	A1cso	3	**AG** – must see both sides equated penalise poor notation/brackets for **A1cso**
(b)	$\theta = \dfrac{\pi}{8} \Rightarrow \cos 4\theta = 0$ $\Rightarrow\ z = \mathrm{i}\tan\dfrac{\pi}{8}$ is root or satisfies equation $((1+z)^4 + (1-z)^4 = 0)$	E1		**or** $\cos 4\theta = 0 \Rightarrow \theta = \dfrac{\pi}{8}$ **AG** be convinced: must have statement must mention $\mathrm{i}\tan\dfrac{\pi}{8}$ **but** may be listed with other 3 roots
	other roots are $\mathrm{i}\tan\dfrac{3\pi}{8}, \mathrm{i}\tan\dfrac{5\pi}{8}, \mathrm{i}\tan\dfrac{7\pi}{8},$	B1	2	
(c)(i)	$\alpha\beta\gamma\delta = \mathrm{i}\tan\dfrac{\pi}{8}\ \mathrm{i}\tan\dfrac{3\pi}{8}\ \mathrm{i}\tan\dfrac{5\pi}{8}\ \mathrm{i}\tan\dfrac{7\pi}{8}$	M1		product of their 4 roots
	$\tan\dfrac{5\pi}{8} = -\tan\dfrac{3\pi}{8}$ and $\tan\dfrac{7\pi}{8} = -\tan\dfrac{\pi}{8}$	B1		May earn this mark in part **(c)(ii)** if not earned here
	$(1+z)^4 + (1-z)^4 = 2z^4 + 12z^2 + 2$	B1		or $z^4 + 6z^2 + 1 \quad (=0)$ seen
	$\alpha\beta\gamma\delta = 1 \quad \Rightarrow \tan^2\dfrac{\pi}{8}\tan^2\dfrac{3\pi}{8} = 1$	A1cso	4	must see i^4 become 1 for final **A1 cso**
(ii)	$\left(\sum\alpha\right)^2 = \sum\alpha^2 + 2\sum\alpha\beta$	M1		
	$\sum\alpha = 0 \Rightarrow \sum\alpha^2 = -2\sum\alpha\beta = -12$	A1		using $z^4 + 6z^2 + 1 = 0$
	$\mathrm{i}^2\left(\tan^2\dfrac{\pi}{8} + \tan^2\dfrac{3\pi}{8} + \tan^2\dfrac{5\pi}{8} + \tan^2\dfrac{7\pi}{8}\right) = -12$	A1		$\tan^2\dfrac{\pi}{8} + \tan^2\dfrac{3\pi}{8} + \tan^2\dfrac{5\pi}{8} + \tan^2\dfrac{7\pi}{8} = 12$ **OE**
	$\tan^2\dfrac{\pi}{8} + \tan^2\dfrac{3\pi}{8} = 6$	A1cso	4	must see i^2 become –1 for final **A1 cso**
	Total		**13**	
(a)	May also earn **M1** for both $(1+\mathrm{i}\tan\theta)^4 = \dfrac{(\cos\theta + \mathrm{i}\sin\theta)^4}{\cos^4\theta}$ or $\dfrac{\cos 4\theta + \mathrm{i}\sin 4\theta}{\cos^4\theta}$ **and** $(1-\mathrm{i}\tan\theta)^4 = \dfrac{(\cos\theta - \mathrm{i}\sin\theta)^4}{\cos^4\theta}$ or $\dfrac{\cos 4\theta - \mathrm{i}\sin 4\theta}{\cos^4\theta}$ and **A1** for completing the proof Provided de Moivre's theorem is used, award **M1** for showing either $\dfrac{2\cos 4\theta}{\cos^4\theta} = 2 - 12\tan^2\theta + 2\tan^4\theta$ or $\left(1+\mathrm{i}\tan\theta\right)^4 + \left(1-\mathrm{i}\tan\theta\right)^4 = 2 - 12\tan^2\theta + 2\tan^4\theta$ and **A1** for completing the proof			
(c)	**Must use equations in z and roots of form $\mathrm{i}\tan\phi$ to earn marks in part (c)**			
(i)	Condone omission of all 4 i's for **M1** but withhold **A1cso** unless $\mathrm{i}^4=1$ is seen **see next page for alternative solution when candidates answer part (c) holistically by converting the quartic equation into a quadratic equation**			

Q8	Alternative Solution	Mark	Total	Comment
(c)	**Alternative part (c)**			
	Substitute $y = z^2$	**M1**		
	$(1+z)^4 + (1-z)^4 = 0$ becomes $(2)(y^2 + 6y + 1) = 0$	**A1**		
	$\tan\frac{5\pi}{8} = -\tan\frac{3\pi}{8}$ and $\tan\frac{7\pi}{8} = -\tan\frac{\pi}{8}$	**B1**		
	Roots are $-\tan^2\frac{\pi}{8}$ and $-\tan^2\frac{3\pi}{8}$	**E1**		explicitly stated and evidence that $i^2 = -1$ has been used
	Sum of roots is -6	**m1**		**FT** their quadratic
	$\tan^2\frac{\pi}{8} + \tan^2\frac{3\pi}{8} = 6$	**A1 cso**		must have earned **E1**
	Product of roots is 1	**m1**		
	$\tan^2\frac{\pi}{8}\tan^2\frac{3\pi}{8} = 1$	**A1 cso**		must have earned **E1**
			8	
	Mark holistically **out of 8** and then allocate marks by giving **up to 4 marks** in **(c)(i)** and the remainder in part **(c)(ii)**			