Question Number	Scheme	Marks
7(a)	$(\cos\theta + \mathrm{i}\sin\theta)^4 = \cos 4\theta + \mathrm{i}\sin 4\theta$	
	$\cos^4\theta + 4\cos^3\theta(\mathrm{i}\sin\theta) + \frac{4\times 3}{2!}\cos^2\theta(\mathrm{i}\sin\theta)^2$ $+\frac{4\times 3\times 2}{3!}\cos\theta(\mathrm{i}\sin\theta)^3 + (\mathrm{i}\sin\theta)^4$	M1
	$= \cos^4\theta + 4\mathrm{i}\cos^3\theta\sin\theta + \mathrm{i}^2 6\cos^2\theta\sin^2\theta + 4\mathrm{i}^3\cos\theta\sin^3\theta + \mathrm{i}^4\sin^4\theta$	A1
	$\cos 4\theta = \cos^4\theta - 6\cos^2\theta\sin^2\theta + \sin^4\theta$	M1
	$\sin 4\theta = 4\cos^3\theta\sin\theta - 4\cos\theta\sin^3\theta$	A1
	$\tan 4\theta = \frac{\sin 4\theta}{\cos 4\theta} = \frac{4\cos^3\theta\sin\theta - 4\cos\theta\sin^3\theta}{\cos^4\theta - 6\cos^2\theta\sin^2\theta + \sin^4\theta}$	
	$\tan 4\theta = \frac{\sin 4\theta}{\cos 4\theta} = \frac{4\tan\theta - 4\tan^3\theta}{1 - 6\tan^2\theta + \tan^4\theta}$ *	M1A1* (6)
7(b)	$x = \tan\theta \qquad \frac{2\tan\theta - 2\tan^3\theta}{1 - 6\tan^2\theta + \tan^4\theta} = \frac{1}{2}\tan 4\theta = 1$	
	$\tan 4\theta = 2$	M1
	$x = \tan\theta = 0.284,\ 1.79$	A1A1 (3) [9]

(a)

M1 Correct use of de Moivre and attempt the complete expansion

A1 Correct expansion. Coefficients to be single numbers but powers of i may still be present.

M1 Equate the real and imaginary parts

A1 Correct expressions for $\cos 4\theta$ and $\sin 4\theta$

M1 Use $\tan 4\theta = \frac{\sin 4\theta}{\cos 4\theta}$ and divide numerator and denominator by $\cos^4\theta$ Only tangents now.

A1* Correct **given** answer, no errors seen.

(b)

M1 Substitute $x = \tan\theta$ and re-arrange to $\tan 4\theta = \pm 2$ or $\pm\frac{1}{2}$

A1A1 A1 for either solution; A2 for both. Deduct one mark only for failing to round either or both to 3 sf
(One correct answer but not rounded scores A0A0; two correct answers neither rounded scores A1A0; two correct answers, only one rounded, scores A1A0)

Question Number	Scheme	Marks
	Alternative for first 4 marks of 7(a): $\sin 4\theta = \frac{1}{2\mathrm{i}}\left(z^4 - z^{-4}\right) = \frac{1}{2\mathrm{i}}\left(\left(\cos\theta - \mathrm{i}\sin\theta\right)^4 - \left(\cos\theta + \mathrm{i}\sin\theta\right)^{-4}\right)$ $= \frac{1}{2\mathrm{i}}\left(\cos^4\theta + 4\mathrm{i}\cos^3\theta\sin\theta - 6\cos^2\theta\sin^2\theta - 4\mathrm{i}\cos\theta\sin^3\theta + \sin^4\theta\right)$ $-\frac{1}{2\mathrm{i}}\left(-\cos^4\theta + 4\mathrm{i}\cos^3\theta\sin\theta + 6\cos^2\theta\sin^2\theta - 4\mathrm{i}\cos\theta\sin^3\theta - \sin^4\theta\right)$ $= 4\cos^3\theta\sin\theta - 4\cos\theta\sin^3\theta$ Similar work leads to $\cos 4\theta = \cos^4\theta - 6\cos^2\theta\sin^2\theta + \sin^4\theta$ Remaining 2 marks as main scheme	M1 M1 A1 A1
M1 **A1** **M1** **A1**	For the expression derived from de Moivre for **either** $\sin 4\theta$ or $\cos 4\theta$ Both shown and correct Attempt the binomial expansion for either, reaching a simplified expression Both simplified expressions correct	