Question Number	Scheme	Notes	Marks
9(a)	$\cos 5\theta + \mathrm{i}\sin 5\theta = (\cos\theta + \mathrm{i}\sin\theta)^5$ $= \cos^5\theta + {}^5C_1\cos^4\theta(\mathrm{i}\sin\theta) + {}^5C_2\cos^3\theta(\mathrm{i}\sin\theta)^2 + {}^5C_3\cos^2\theta(\mathrm{i}\sin\theta)^3 + {}^5C_4\cos\theta(\mathrm{i}\sin\theta)^4 + (\mathrm{i}\sin\theta)^5$		M1
	$(\sin 5\theta =) 5\cos^4\theta\sin\theta - 10\cos^2\theta\sin^3\theta + \sin^5\theta$	M1: Equates imaginary parts A1: Correct expression	M1 A1
	$= 5\sin\theta(1-\sin^2\theta)^2 - 10\sin^3\theta(1-\sin^2\theta) + \sin^5\theta$ $= 5\sin\theta - 10\sin^3\theta + 5\sin^5\theta - 10\sin^3\theta + 10\sin^5\theta + \sin^5\theta$ $= 16\sin^5\theta - 20\sin^3\theta + 5\sin\theta$	M1: Uses $\cos^2\theta = 1-\sin^2\theta$ and reaches an expression of the correct form A1: Correct expression or $a=16,\ b=-20,\ c=5$ $\sin 5\theta$ must have been seen at some point	M1 A1
			(5)
(b)	$\left(\text{For } \theta = \frac{k\pi}{5},\ k \in \mathbb{Z},\ \sin 5\theta = \sin k\pi = 0 \Rightarrow\right)$ $16\sin^5\theta - 20\sin^3\theta + 5\sin\theta = 0$	Sets their answer to (a) = 0 Could be implied	M1
	$\sin\theta(16\sin^4\theta - 20\sin^2\theta + 5) = 0$ $\Rightarrow \sin^2\theta = \frac{-(-20) \pm \sqrt{(-20)^2 - 4(16)(5)}}{2(16)} = \frac{20 \pm \sqrt{80}}{32}$	Solves their quadratic in $\sin^2\theta$ to find both roots (usual rules)	M1
	$\Rightarrow \sin^2\frac{k\pi}{5} = \frac{5 \pm \sqrt{5}}{8},\ 0$	A1: $\frac{5 \pm \sqrt{5}}{8}$ oe B1: 0	A1, B1
			(4)
			Total 9

Additional Notes

(a)

M1: Attempts to expand $(\cos\theta + \mathrm{i}\sin\theta)^5$ to obtain an expression of the correct form for the three imaginary terms. May use $c + \mathrm{i}s$ notation. Need only see the imaginary terms, condone missing or incorrect real terms. Binomial coefficients may be as expressions or values, if values only used they must be correct. The powers of i may be processed in the initial expansion. Allow invisible brackets if recovered.

M1: Extracts the imaginary terms from the expansion. The equating to $\sin 5\theta$ may be tacit at this stage.

A1: Correct expression for $\sin 5\theta$ (though the $\sin 5\theta$ need not be seen yet) in terms of $\sin\theta$ and $\cos\theta$.

M1: Uses $\cos^2\theta = 1-\sin^2\theta$ to eliminate $\cos\theta$ from the expression to get to an expanded equation in $\sin\theta$ only. Terms need not be gathered at this stage, but the simplification may be done in one step.

A1: Correct answer including the $\sin 5\theta$ having been seen identified with the expression at some stage if not included at the end. Accept values for *a*, *b* and *c* stated following reaching a suitable equation in $\sin\theta$

(b)

M1: Recognition of the correct process seen by either their answer to (a) equal to zero, which by be implied, or by an attempt to solve it (the "=0" being implied, accept one correct root for their equation as evidence).

M1: Correct method to solve the quadratic in $\sin^2\theta$ after factoring out the $\sin\theta$ - both roots must be given. Condone for this mark if they mistakenly mislabel the solution to the quadratic in $\sin^2\theta$ as $\sin\theta$, but do not

allow the A if they go on square their values. Note answer stated directly from the quintic score M0. They must at least identify the quadratic in $\sin^2\theta$ before reaching the answers (from calculator).
A1: Correct answers only but accept equivalent forms.

B1: For 0 identified as a value for $\sin^2\frac{k\pi}{5}$ - this can come from anywhere (method not required).

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