Question Number	Scheme	Marks
2	$\mathrm{f}(z)=z^4+\lambda z^3+14z^2+9\lambda z+45$	
(a)	$\{\mathrm{f}(3i)=\}\quad (3\mathrm{i})^4+\lambda(3\mathrm{i})^3+14(3\mathrm{i})^2+9\lambda(3\mathrm{i})+45$ $=81\mathrm{i}^4+27\lambda\mathrm{i}^3+126\mathrm{i}^2+27\lambda\mathrm{i}+45$ $=81-27\lambda\mathrm{i}-126+27\lambda\mathrm{i}+45$ $=0^*$	M1 A1*
		(2)
(b)	$(z+3i)(z-3i)=z^2+9$	B1
	$\Rightarrow z^2+\lambda z+5$	M1 A1
	$b^2-4ac<0\Rightarrow\lambda^2-20<0$	M1
	$-2\sqrt{5}<\lambda<2\sqrt{5}$	A1
		(5)
		Total 7

Notes

(a)

M1: Attempts f(3i) and obtains 2 of the first 4 terms on line 3 in the box for (a) (ie with the powers of i dealt with correctly in two of the first four terms)

A1*: Obtains 0 from correct work. (No need for a concluding comment.)

(b)

B1: Obtains z^2+9, may be implied (e.g. by use of product and sum of roots to directly deduce the other factor).

M1: Uses $z^2\pm kz\pm 9$and f(z) to attempt a further quadratic with real coefficients, finding at least two terms. Ignore remainder if long division used. Correct first and last terms achieved can imply the mark. If the quadratic is never directly given but working to find the middle coefficient is shown then allow the mark.

A1: Correct factor. Condone work in x

M1: Uses $b^2-4ac<0$ oe with their 3TQ. Condone $\leqslant 0$ used for the M mark.

A1: Correct exact range. Any equivalent notation e.g., $|\lambda|<\sqrt{20}$, or if using interval notaion accept $(-2\sqrt{5},2\sqrt{5})$ Condone being given as separate inequalities. Must not be in terms of a variable other than λ

SC 1 If they obtain an incorrect factor $z^2-\lambda z+5$ they could still obtain the correct final answer and we will allow B1M1A0M1A1 in such cases.

SC 2 Some are finding a quadratic factor z^2+bz+5 without fiding b in terms of λ, going to apply $b^2-20<0$ and only changing b to λ later **without any clear justification**. We will alllow SC max B1M1A0M1A1 for such cases.