Question Number	Scheme	Marks
3	$w = \dfrac{z}{z+4\mathrm{i}}$	
	$w(z+4\mathrm{i}) = z \Rightarrow z(1-w) = 4\mathrm{i}w$ or $z = \dfrac{4\mathrm{i}w}{1-w}$ oe	M1A1
	$\lvert z\rvert = 3 \quad \left\lvert\dfrac{4\mathrm{i}w}{1-w}\right\rvert = 3$	dM1
	$\lvert 4\mathrm{i}w\rvert = 3\lvert 1-w\rvert$	
	$w = u+\mathrm{i}v \quad 16\left(u^2+v^2\right) = 9\left((1-u)^2+v^2\right)$	ddM1A1
	$16u^2+16v^2 = 9\left(1-2u+u^2+v^2\right)$	
	$7u^2+7v^2+18u-9=0$	
	$\left(u+\dfrac{9}{7}\right)^2+v^2 = \dfrac{144}{49}$	dddM1
	Centre $\left(-\dfrac{9}{7},0\right)$ Radius $\dfrac{12}{7}$	A1A1 (8)

	Notes
(a)	
M1	re-arrange to $z = \ldots$ or an expression $z(\alpha w+\beta) = \gamma w+\delta$
A1	correct result
dM1	dep (on first M1) using $\lvert z\rvert = 3$ with their previous result
ddM1	dep (on both previous M marks) use $w = u+\mathrm{i}v$ (or $w = x+\mathrm{i}y$ or any other pair of letters) and attempts the squares of the moduli. The i's must be dealt with correctly, but allow e.g. $3^2 \to 3$
A1	for a correct equation quadratic in u and v after squaring (including squaring coefficients).
dddM1	dep (on all previous M marks) re-arrange to the completed square form of the equation of a circle (same coeffs for the squared terms) or implied by a correct centre or radius following a correct equation with terms gathered.
A1	either correct and exact.
A1	both correct and exact.
	Note: Allow recovery for the last three A's if all that is incorrect in is the wrong sign in their expression for z, ie $z = \dfrac{-4\mathrm{i}w}{1-w}$
	If you see alternative methods, e.g. via Apollonian approaches or attempts to use $z = x + \mathrm{i}y$ in the original equation, that you feel are worthy of credit please use Review to consult your team leader.