Question Number	Scheme	Notes	Marks
4	If z is **restated** incorrectly, e.g., "$z=3+4\text{i}$" is seen allow a maximum of M1dM1A0 B0M1A1M1A0		
(a)	$z^2-3=(-3+4\text{i})(-3+4\text{i})-3$ $=9-24\text{i}-16-3$ $=-10-24\text{i}$	Substitutes $z=-3+4\text{i}$ into z^2-3, expands and reaches $a+b\text{i}$ $(a,\ b\neq 0)$ Implied by $-10-24\text{i}$ seen and condone misapplication of the modulus e.g., using $a+b\text{i}$ from $\lvert -a-b\text{i}\rvert$	**M1**
	$\lvert z^2-3\rvert=\sqrt{"10"^2+"24"^2}$	Correct expression for modulus of their $a+b\text{i}$ $(a,\ b\neq 0)$ Allow with no working for the modulus provided answer correct for their $a+b\text{i}$ **Requires previous M mark.**	**dM1**
	26	26 only from correct work. e.g., $\lvert -10+24\text{i}\rvert=26$ is A0 Answer only or without $-10-24\text{i}$ is no marks.	**A1**
			(3)
(b)	$\left(z=-3+4\text{i}\Rightarrow\right)\quad z^*=-3-4\text{i}$	Correct conjugate. Can be implied	**B1**
	$\frac{50}{z^*}=\frac{50}{-3-4\text{i}}\times\frac{-3+4\text{i}}{-3+4\text{i}}\quad\left[=50\times\frac{-3+4\text{i}}{25}\right]$ or $\frac{1}{z^*}=\frac{1}{-3-4\text{i}}\times\frac{-3+4\text{i}}{-3+4\text{i}}\quad\left[=\frac{-3+4\text{i}}{25}\right]$	A correct multiplier seen that would make the denominator real for $\frac{50}{z^*}$ or $\frac{1}{z^*}$ where $z^*=\pm 3\pm 4\text{i}$ (**except** $-3+4\text{i}$). If the multiplier is not seen must see something better than $50\times\frac{-3+4\text{i}}{25}$ or $\frac{-3+4\text{i}}{25}$ or –6+8i e.g., $\frac{50}{z^*}=\frac{50(-3+4\text{i})}{9+16}$	**M1**
	$\frac{50}{z^*}=2(-3+4\text{i})\quad$ or $\quad 2z$	Obtains $2(-3+4\text{i})\quad$ or $\quad 2z$ Just $-6+8\text{i}$ is insufficient Allow $k=2$ provided "$=kz$" or "$=k(-3+4\text{i})$" is seen	**A1**
			(3)
Using Result	May see: $\frac{50}{-3-4i}=k(-3+4\text{i})\Rightarrow\frac{50}{9+16}=k\Rightarrow k=2$ B1: Correct z^* M1: $\frac{50}{9+16}=k$ or better after multiplication A1*: $k=2$		
Alt **Using** $\frac{1}{z^*}=\frac{z}{\lvert z\rvert^2}$	$\frac{1}{z^*}=\frac{z}{\lvert z\rvert^2}$ oe e.g., $z^*z=\lvert z\rvert^2$	States or uses $\frac{1}{z^*}=\frac{z}{\lvert z\rvert^2}$ oe	**B1**
	$\frac{c}{z^*}=\frac{cz}{\lvert z\rvert^2},\quad \lvert z\rvert=\sqrt{3^2+4^2}=\ldots$	Expresses $\frac{c}{z^*}$ as $\frac{cz}{\lvert z\rvert^2}$ and attempts $\lvert z\rvert$ or $\lvert z\rvert^2$ where c = 1 or 50	**M1**
	$\frac{50}{z^*}=\frac{50z}{25}=2z$	Correctly finds $2z$ Allow $k=2$ provided "$=kz$" or "$=k(-3+4\text{i})$" is seen	**A1**

Question Number	Scheme	Notes	Marks
4(c)	$\arctan\left(\pm\frac{4}{3}\right)=\pm 0.927...\left(53.13^\circ\right)$ or $\arctan\left(\pm\frac{3}{4}\right)=\pm 0.643...\left(36.86^\circ\right)$ May see equivalent trig in which case the hypotenuse should be correct	Finds a relevant angle which could be in degrees correct to 2sf so accept awrt $\pm 0.93\ \left(53^\circ\right)$ or $\pm 0.64\ \left(37^\circ\right)$ If neither value is seen allow implication from the work May see e.g., $\tan^{-1}\left(\pm\frac{8}{6}\right)=...$ M0 if arg 2z replaced with 2 arg z	**M1**
	$\left[\theta=\pi-0.927295...\quad\theta=\frac{\pi}{2}+0.643501...\right]$ $\theta=2.21$	**Final answer** of awrt 2.21 – **do not isw**. (n.b. $\theta=2.214297436...$) Final answer of e.g., "$\pi-0.927$" is A0 Answer only scores both marks. Answer only in degrees (awrt 127°) is M1A0	**A1**
Note: allow access to both marks even if k in part (b) was incorrect			**(2)**
			Total 8