Question	Scheme		Marks	AOs
4(i) (a)	$\frac{2+3i}{5+i}\times\frac{5-i}{5-i}$	$2+3i=k(1+i)(5+i)=...$	M1	1.1a
	$\frac{10-2i+15i+3}{25+1}$ or $\frac{13+13i}{26}$	$2+3i=k(5+i+5i-1)=...$	dM1	1.1b
	$\frac{1}{2}(1+i)$ cso	$2+3i=k(4+6i)$ therefore $\frac{2+3i}{5+i}=k(1+i)$ where $k=\frac{1}{2}$ cso	A1	2.1
			(3)	
(i)(b)	$n=4$		B1	2.2a
			(1)	
(ii)	$\lvert z\rvert=3$		B1	1.2
	$\arg(z^{10})=10\arg(z)=-\frac{5\pi}{3}\Rightarrow\arg(z)=...\left\{-\frac{\pi}{6}\right\}$ $\arg(z^{10})=10\arg(z)=\frac{\pi}{3}\Rightarrow\arg(z)=...\left\{\frac{\pi}{30}\right\}$		M1	1.1b
	$z=3\left(\cos\left(-\frac{\pi}{6}\right)+i\sin\left(-\frac{\pi}{6}\right)\right)=...$		M1	2.1
	$z=\frac{3\sqrt{3}}{2}-\frac{3}{2}i$ or $a=\frac{3\sqrt{3}}{2}$ and $b=-\frac{3}{2}$		A1	1.1b
			(4)	
	Alternative $a^2+b^2=9$		B1	1.2
	$10\arg z=-\frac{5\pi}{3}\Rightarrow\arg z=-\frac{5\pi}{3}\div 10$ Or e.g $10\arg(z)=\frac{\pi}{3}\Rightarrow\arg(z)=...\left\{\frac{\pi}{30}\right\}$		M1	1.1b
	Forming and solving simultaneous equations to find a value for *a* or *b* $\frac{b}{a}=\arctan\left(-\frac{\pi}{6}\right)\Rightarrow\frac{b}{a}-\frac{\sqrt{3}}{3}\Rightarrow b=-a\frac{\sqrt{3}}{3}$ or $\frac{b}{a}=\arctan\frac{\pi}{30}\Rightarrow b=0.104...a$		M1	2.1
	$z=\frac{3\sqrt{3}}{2}-\frac{3}{2}i$ or $a=\frac{3\sqrt{3}}{2}$ and $b=-\frac{3}{2}$		A1	1.1b
			(4)	
				(8 marks)

Notes:

(i) (a)

M1: Selects the process $\frac{2+3\text{i}}{5+\text{i}} \times \frac{5-\text{i}}{5-\text{i}}$

dM1: Evidence of multiplying out brackets

A1: Achieves $\frac{1}{2}(1+\text{i})$ or $\frac{13}{26}(1+\text{i})$ with no errors cso, isw.

Note: Correct answer from no working score no marks

Note: Going from $\frac{13+13\text{i}}{26}$ and then stating $k=\frac{1}{2}$ is A0, they have not shown the form asked for

Alternative

M1: Multiplies across by $(5+\text{i})$ and expands the brackets

dM1: Collects terms

A1: Achieves $2+3\text{i}=k(4+6\text{i})$ and draws the conclusion that therefore $\frac{2+3\text{i}}{5+\text{i}}=k(1+\text{i})$ where $k=\frac{1}{2}$

(i) (b)

B1: Deduces $n=4$ only

(ii)

Note: Send to review any attempts where they are finding additional solutions such as arguments of *z* is $\frac{(6k-5)\pi}{30}$ **For example correctly uses** $\arg(z)=\frac{\pi}{30}$

B1 (M1 on ePen): $|z|=3$ can be implied by $a^2+b^2=9$ isw

M1: Uses $\arg(z_1z_2)=\arg(z_1)+\arg(z_2)$ to find $\arg(z)=-\frac{5\pi}{3}\div 10$ or $\arg(z)=\frac{\pi}{3}\div 10$

M1: Uses $z=\text{their}|z|(\cos(\text{their arg})+\text{i}\sin(\text{their arg}))$ to find the complex number *z* or values for *a* or *b*.

As long as the modulus has changed.

A1: Correct complex number or values for *a* and *b*.

Alternative

B1: $a^2+b^2=9$ isw

M1: Uses $\arg(z_1z_2)=\arg(z_1)+\arg(z_2)$ to find $\arg(z)=-\frac{5\pi}{3}\div 10$

M1: Uses the argument of *z* find an equation in *a* and *b* . Then solve simultaneously to find a value for *a* or *b*.

As long as $\sqrt{a^2+b^2}\neq 59049$

A1: Correct complex number or values for *a* and *b*.

Note there are other correct answers

$z_1=\frac{3\sqrt{3}}{2}-\frac{3}{2}\text{i}$

$z_2=\text{awrt } 2.98+\text{awrt } 0.314\text{i}$

$z_3=\text{awrt } 2.23+\text{awrt } 2.01\text{i}$

$z_4=\text{awrt } 0.624+\text{awrt } 2.93\text{i}$

$z_5=\text{awrt } -1.22+\text{awrt } 2.74\text{i}$

$z_6=-\frac{3\sqrt{3}}{2}+\frac{3}{2}\text{i}$

$z_7=\text{awrt } -2.98+\text{awrt } -0.314\text{i}$

$z_8=\text{awrt } -2.23+\text{awrt } -2.01\text{i}$

$z_9=\text{awrt } -0.624+\text{awrt } -2.93\text{i}$

$z_{10}=\text{awrt } 1.22+\text{awrt } -2.74\text{i}$