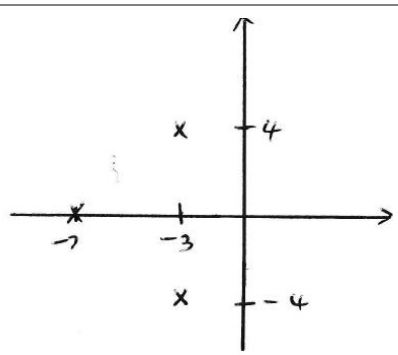
Question	Scheme	Marks	AOs
2(a)	$z^* = -3-4\text{i}$ $\left(z-\left(-3+4\text{i}\right)\right)\left(z-\left(-3-4\text{i}\right)\right) = z^2+pz+q$ $\left\{\text{f}\left(z\right)=\right\}\left(z^2+pz+q\right)\left(z+r\right)$	M1	3.1a
	$\left(z^2+6z+25\right)\left(z+7\right)$	A1	1.1b
	Multiplies out $\left(z^2+6z+25\right)\left(z+7\right) = ...\alpha z^2+\beta z...$	M1	1.1b
	$z^3+13z^2+67z+175$ or $a=13, b=67$	A1	1.1b
		(4)	
	Alternative 1 $z^* = -3-4\text{i}$ and uses product of roots = – 175 to find the third root	M1	3.1a
	Third root = –7	A1	1.1b
	Either Uses sum roots = – a to find a value for a **or** uses pair sum = b to find a value for b **Or** $\left(z-\left(-3+4\text{i}\right)\right)\left(z-\left(-3-4\text{i}\right)\right)\left(z-\text{their third root}\right) = ...$	M1	1.1b
	$a=13, b=67$	A1	1.1b
		(4)	
	Alternative 2 $\left(-3+4\text{i}\right)^3+a\left(-3+4\text{i}\right)^2+b\left(-3+4\text{i}\right)+175=0$ $\Rightarrow 117+44\text{i}+a\left(-7-24\text{i}\right)+b\left(-3+4\text{i}\right)+175=0$ Equates real and imaginary to form two linear simultaneous equations	M1	3.1a
	$117-7a-3b+175=0 \Rightarrow -7a-3b=-292$ $44-24a+4b=0 \Rightarrow -24a+4b=-44$	A1	1.1b
	Solves simultaneously to find values for a or b	M1	1.1b
	$a=13, b=67$	A1	1.1b
		(4)	
(b)		$-3+4\text{i},\ -3-4\text{i}$ -7	B1 B1	1.1b 2.2a
		(2)	

(c)	$-5+4i,\ -5-4i,\ -9$	B1ft	2.2a
		(1)	
			(7 marks)

Notes:

(a)

M1: Uses the given root and its complex conjugate to form a quadratic equation. Uses the quadratic equation to write $f(z)$ in the form $(z^2+pz+q)(z+r)$ where *p*, *q* and *r* are real values

A1: Correct expression for $f(z)=(z^2+6z+25)(z+7)$

M1: Multiplies out and simplifies to find the z^2 or *z* term.

A1: Correct values for *a* and *b* or cubic

Alternative 1

M1: Uses the complex conjugate and product of roots = – 175 to find the third root.

A1: Correct third root

M1: A complete method to find the values of *a* or *b*. Either uses the sum and pairs sum or multiplies out three brackets $(z-(-3+4i))(z-(-3-4i))(z-\text{their third root})$ to find the z^2 or *z* term.

A1: Correct values for *a* and *b* or cubic

Alternative 2

M1: Substitutes $-3+4i$ or $-3-4i$ into $f(z)$, sets the real and imaginary parts = 0 to form two simultaneous equations in *a* and *b*.

A1: Correct, unsimplified equations.

M1: Solves simultaneous equations to find values for *a* or *b* following an attempt at $f(-3+4i)=0$ or $f(-3-4i)=0$. Allow this mark for seeing a value for *a* or *b* following simultaneous equation, you do not need to check.

A1: Correct values for *a* and *b*.

(b)

B1: Correctly plotting $-3+4i,\ -3-4i$

B1: Correctly plotting – 7

(c)

B1ft: $-5+4i,\ -5-4i$ and subtracts 2 from their real root shown on their Argand diagram