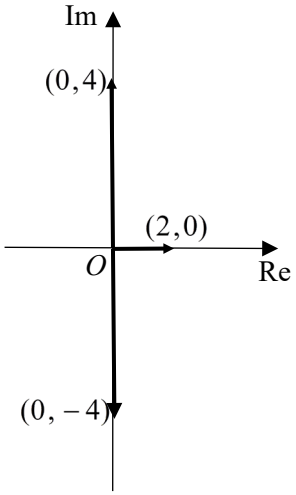
Question Number	Scheme	Notes	Marks
2.	$f(z) = z^3 - 2z^2 + 16z - 32$		
(a)	• $\{f(2) =\}\ 8 - 8 + 32 - 32 = 0$ **or** • $\{f(2) =\}\ (2)^3 - 2(2)^2 + 16(2) - 32 = 0$	Uses working to show that $f(2) = 0$	B1
			(1)
(b)	$\{f(z) =\}\ (z-2)(z^2+16)$	Uses only $(z-2)$ to find a quadratic factor. e.g. using long division with $(z-2)$ to get as far as $z^2 + ...$ or factorising to give $(z-2)(z^2+...)$ **Note:** 1st M1 can be given for sight of a correct (z^2+16)	M1
	$\{(z^2+16) = 0 \Rightarrow z =\}\ \pm 4i$	Correct method of solving their quadratic factor	M1
	$\{f(z) = 0 \Rightarrow z =\}\ 2, 4i, -4i$	$2, 4i$ **and** $-4i$	A1
			(3)
(c)		**Criteria** • The number 2 plotted correctly on the positive real axis • **dependent on a correct method for solving their quadratic factor or dependent on deducing correct roots of 2, 4i, - 4i** Their final two roots of the form $\pm\mu i,\ \mu \neq 0$ or the form $\lambda \pm \mu i,\ \mu \neq 0,$ are plotted correctly	
		Satisfies at least one of the criteria	B1ft
		Only 3 roots plotted, satisfying both criteria with some indication of scale or coordinates stated. **Note:** The pair of complex roots should be approximately symmetrical about the real axis **Note:** Condone the labels $4i, -4i$ marked on the *y*-axis	B1ft
			(2)
			6

Question 2 Notes

2. (b)	**Note**	You can assume $x \equiv z$ for solutions in this part
	Note	No algebraic working leading to $z = 2, 4i, -4i$ is M0 M0 A0
	Note	Allow M1 M1 A1 for $(z-2)(z+4i)(z-4i)\ \{=0\} \Rightarrow z = 2, 4i, -4i$
	Note	Allow M1 M0 A0 for $(z-2)(z+4i)(z-4i)\ \{=0\}$ by itself, but please note that you cannot recover the final M1 A1 marks for work seen in part (c)
	Note	Give M1 M0 A0 for $(z-2)(z^2+16)\ \{=0\} \Rightarrow (z-2)(z+4i)(z-4i)\ \{=0\}$ by itself, but please note that you cannot recover the final M1 A1 marks for work seen in part (c)
	Note	$z = \pm\sqrt{16i}$ unless recovered is 2nd M0 1st A0
	Note	Give 2nd M1 for $z^2 + k = 0,\ k > 0 \Rightarrow$ **at least one of either** $z = \sqrt{k}\,i$ or $z = -\sqrt{k}\,i$ So, e.g. give 2nd M1 for $z^2 + 16 = 0 \Rightarrow z = 4i$
	Note	Give 2nd M0 for $z^2 + k = 0,\ k > 0 \Rightarrow z = \pm ki$
	Note	Give 2nd M0 for $z^2 + k = 0,\ k > 0 \Rightarrow z = \pm k$ or $z = \pm\sqrt{k}$
	Note	Give 2nd M1 for $z^2 - k = 0,\ k > 0 \Rightarrow$ **both** $z = \sqrt{k}$ **and** $z = -\sqrt{k}$
	Note	**Special Case:** If ***their quadratic*** factor $z^2 + "a"z + "b"$ **can** be factorised then give Special Case 2nd M1 for correct factorisation leading to $z = ...$ Otherwise, give 2nd M0 for applying a method of factorisation to solve their 3TQ.

	Question 2 Notes Continued	
2. (b)	**Note**	**<u>Reminder:</u>** Method Mark for solving a 3TQ, "$az^2 + bz + c = 0$" **Formula:** Attempt to use the correct formula (with values for a, b and c) **Completing the square:** $\left(z \pm \frac{b}{2}\right)^2 \pm q \pm c = 0, q \neq 0,$ leading to $z = ...$
	Note	Send to review solutions involving α, β, γ roots. E.g. $-2 = -(\alpha + \beta + \gamma)$
(c)	**Note**	Drawing the lines $z = 2$, $z = 4\text{i}$, $z = -4\text{i}$ instead of plotting the points $(2, 0), (0, 4)$ and $(0, -4)$ is B0 B0
	Note	Indication of coordinates includes stating e.g. $z_1 = 2$, $z_2 = 4\text{i}$, $z_3 = -4\text{i}$ and plotting z_1, z_2 and z_3 in their relevant positions on an Argand diagram
(b), (c)	**Note**	You cannot recover work for part (b) in part (c)