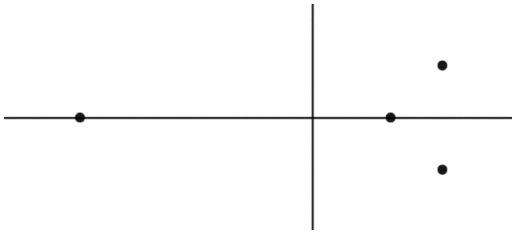
Question Number	Scheme	Notes	Marks
2	$f(z) = z^3 - 13z^2 + 59z + p$		
(a)	$[f(3) =] 3^3 - 13(3)^2 + 59(3) + p$ or e.g., $27 - 117 + 177 + p$ or $z^2 - 10z + 29$ $z-3 \overline{)z^3 - 13z^2 + 59z + p}$ $\underline{z^3 - 3z^2}$ $-10z^2 + 59z$ $\underline{-10z^2 + 30z}$ $29z + p$ $\underline{29z - 87}$ 0	Attempts $f(3)$. Must see more than just $87 + p$ Allow one slip (e.g., a miscopy of one coefficient, or one incorrect value/sign if expression just given as 27 – 117 +177 + *p*) **Alternatively** long divides by $z-3$ obtaining a 3TQ with two terms of $z^2 - 10z + 29$ correct. Could use synthetic division. An attempt at equating coefficients/factorising requires 2 correct values for the *a*, *b* and *c* of $az^2 + bz + c$	**M1**
	$f(3) = 0 \Rightarrow p = -87$ *	Obtains "$p = -87$" only with no errors but condone work in *x* "=0" must have been seen before $p = -87$ if f(3) attempted but allow just $p = -87$ following a full and correct attempt via division/equating coefficients etc with no errors.	**A1* (shown as B1 on ePen)**
			(2)
(b)	Allow equivalent work in *x*. Allow use of a calculator to solve a **quadratic**. Solutions that just follow $z^3 - 13z^2 + 59z - 87 = 0$ score no marks. There are no marks if $z^2 - 10z + 29$ has clearly been produced by using $(z-(5+2i))(z-(5-2i))$		
	$(z^3 - 13z^2 + 59z - 87) \div (z-3)$ $= \ldots [z^2 - 10z + 29]$	M1: Uses $z \pm 3$ with f(*z*) (not their f(*z*)) to obtain a 3TQ expression with evidence of any appropriate method including inspection (must be evidence of use of $z \pm 3$) or equating coefficients. Ignore any remainder if long division is used and may see $z^2 - 16z + 107$ $(r(-408))$ if $z+3$ used. Must be seen or referred to in (b) A1: Correct quadratic	**M1** **A1**
	$z = \dfrac{-(-10) \pm \sqrt{(-10)^2 - (4)(1)(29)}}{2(1)}$ or $(z-5)^2 - 25 + 29 = 0 \Rightarrow z = 5 \pm \sqrt{-4}$	Solves their 3TQ arising from using $(z-3)$ only as a factor (usual rules but allow if one correct root if calculator used on their quadratic) If a sum/product of roots method is used on their 3TQ$(\text{i.e., } 2a = -("-10"),\ a^2 + b^2 = "29")$ it must be complete and condone only sign errors. Do not allow just $5 \pm 2i$ following an incorrect quadratic **Requires previous M mark.**	**dM1**
	$\left(z = \dfrac{10 \pm \sqrt{-16}}{2} = \right)$ $5 \pm 2i$	$5 \pm 2i$ or 5 + 2i, 5 – 2i only. Not $5 \pm 2\sqrt{-1}$ Accept $\pm 2i + 5$	**A1**
			(4)

Question Number	Scheme	Notes	Marks
2(c)	 Look for this arrangement if correct but note potential ft	Correct diagram ft their $a \pm b\text{i}$ $(a,\ b \neq 0)$ Diagram should be roughly symmetrical in the real axis. The point on the negative *x*-axis should be further from the origin than the point on the positive *x*-axis but ignore any other scaling issues – just look for the $a \pm b\text{i}$ points to be placed in the correct quadrants, roughly aligned vertically and placed correctly relative to the given point that is on the same side of the *y*-axis. Points/axes may be unlabelled or mislabelled. If vectors/lines are used the end points must satisfy the conditions above.	**B1ft**
			(1)
(d)	$2\left(\sqrt{\left("5"-(-9)\right)^2+"2"^2}+\sqrt{("5"-3)^2+"2"^2}\right)$	A correct numerical expression for the perimeter ft their $a \neq 0$ or 3 or -9 and $b \neq 0$ This mark requires working with points that would form a convex or concave kite where the *x*-axis is a line of symmetry. Working must be seen if $a \pm b\text{i}$ incorrect but allow just $4\sqrt{5}+4\sqrt{17}$ oe from using $-5 \pm 2\text{i}$	**M1**
	$\left[=2\left(\sqrt{14^2+2^2}+\sqrt{2^2+2^2}\right)=2\left(\sqrt{200}+\sqrt{8}\right)\right]$ $=24\sqrt{2}$	$24\sqrt{2}$ or any simplified equivalent e.g., $12\sqrt{8}$ or $2\sqrt{288}$ but not $\sqrt{1152}$. Correct answer scores both marks and allow M1 A0 for just $\sqrt{1152}$	**A1**
			(2)
			Total 9