

STEP II, 2020, Q7 EC

This was the least popular of the pure questions and also the one on which marks were lowest on average.

Many candidates were able to show the first result, that $|w - 1|$ is independent of t . However, candidates often did not explain well enough the connection between the form of z and the line $Re(z) = 3$.

The next part of part (i) required noting that the centre lies on the real axis and working out $|w - c|$. Some candidates guessed the value of c . Common mistakes here included guessing $c = 1, p - 2$, or failing to note conditions in which $|w - c|$ is independent of t . In many solutions the absolute value sign on the radius was forgotten.

Part (ii) was similar to the previous part but required noting that the centre lies on the imaginary axis and working out $|w - ci|$. In both parts a common attempt was the guess the centre to be at a point $z = a + bi$, few candidates were successful using this method. Again, absolute value signs on the radius were regularly forgotten.

Another successful method employed by candidates in all parts of the question was to use the substitution $t = \tan \frac{\theta}{2}$, $t = (p - 2) \tan \frac{\theta}{2}$, $t = q \tan \frac{\theta}{2} + 2$ and using various trig identities to achieve the centre and radius. A few students also expressed t in terms of $Re(w)$ and $Im(w)$ and used that to obtain the equation of a circle in \mathbb{R}^2 .



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