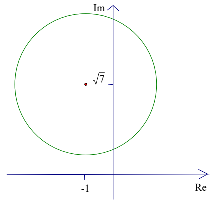
Question	Answer	Marks	Guidance
(a)	Substitute $x = -1+\sqrt{7}\mathrm{i}$ in the equation and attempt expansions of x^2 and x^3	*M1	
	Use $\mathrm{i}^2 = -1$ correctly at least once and solve for k	DM1	$2\left(20-4\sqrt{7}\mathrm{i}\right)+3\left(-6-2\sqrt{7}\mathrm{i}\right)+14\left(-1+\sqrt{7}\mathrm{i}\right)+k=0$
	Obtain answer $k = -8$	A1	
			SC B1 only for those who show no working for the cube and square and obtain answer $k = -8$.
	Alternative method for question (a)		
	Attempt division by $\left(x+1-\sqrt{7}\mathrm{i}\right)$ as far as $2x^2+z_1x+\ldots$	*M1	See division on next page.
	Use $\mathrm{i}^2 = -1$ correctly at least once and obtain $2x^2+z_1x+z_2+$ remainder	DM1	
	Obtain answer $k = -8$	A1	
		3	

Question	Answer	Marks	Guidance
(b)	State answer $-1-\sqrt{7}\mathrm{i}$	**B1**	Can be seen simply stated on its own, or in a list of roots. Allow if stated clearly in part **10(a)**.
	Carry out a method for finding a quadratic factor with zeros $-1+\sqrt{7}\mathrm{i}$ and $-1-\sqrt{7}\mathrm{i}$	**M1**	Or state $\left(x-\left(-1+\sqrt{7}\mathrm{i}\right)\right)\left(x-\left(-1-\sqrt{7}\mathrm{i}\right)\right)(2x-p)$
	Obtain x^2+2x+8	**A1**	Or obtain $\left(-1+\sqrt{7}\mathrm{i}\right)\left(-1-\sqrt{7}\mathrm{i}\right)p=-8$ Or obtain $\left(-1+\sqrt{7}\mathrm{i}\right)+\left(-1-\sqrt{7}\mathrm{i}\right)+\frac{p}{2}=-\frac{3}{2}$
	Obtain root $x=\dfrac{1}{2}$, or equivalent, via division or inspection	**A1**	Needs to follow from the working.
		4	

Question	Answer	Marks	Guidance
(c)	Show a circle with centre $-1+\sqrt{7}\mathrm{i}$	**B1**	 If the scales are very different from each other then B1 for centre in the correct position and B1 for an ellipse. If there is more than one circle the max score is B1.
	Show circle with radius 2 and centre not at the origin There needs to be some evidence of scale e.g. radius marked or a scale on the axes	**B1**	
		2	
(d)	Carry out a complete method for calculating the maximum value of arg z for correct circle	**M1**	e.g. $\frac{\pi}{2}+\tan^{-1}\frac{1}{\sqrt{7}}+\frac{\pi}{4}$ Can be implied by $155.7°$.
	Obtain answer 2.72 radians	**A1**	CAO. The question requires radians.
		2	