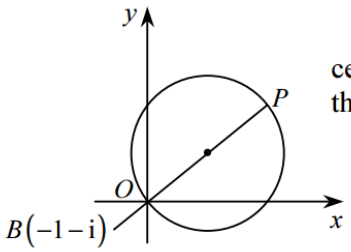
(a) Sketch on an Argand diagram the circle with equation

$$|z - 1 - i| = \sqrt{2}.$$ *(2 marks)*

(b) The point P lies on the circle and represents the complex number z. Show on your Argand diagram the position of P when the value of $|z + 1 + i|$ is as large as possible, and determine this largest value. *(3 marks)*

Q	Solution	Marks	Total	Comments
4 (a)	 centre (1, 1) through O	B1 B1	2	
(b)	Correct distance BP identified $BP = 3\sqrt{2}$	B1 M1 A1√	3	for B and P in correct positions
	Total		**5**	

(a) Draw an Argand diagram to show the points A and B which represent the complex numbers $1 - 3i$ and $5 - i$ respectively. *(1 mark)*

(b) (i) The circle C has AB as a diameter. Find its radius and the coordinates of its centre. *(4 marks)*

(ii) Write down the equation of C in the form

$$|z - z_0| = k.$$ *(2 marks)*

Q	Solution	Marks	Total	Comments
5 (a)	Point plotted correctly	B1	1	
(b)(i)	The centre must be $\frac{1-3i+5-i}{2} = 3 - 2i$	M1A1		Accept (3, -2), but (3, -2i) gets AO
	The radius must be $\sqrt{((3-1)^2 + (-2+3)^2)} = \sqrt{5}$	M1A1	4	$\sqrt{(3-1)^2 + (-2i+3i)^2}$ MO If diameter is taken as $\sqrt{20}$ or radius taken as $\sqrt{20}$ allow B1
(ii)	$\therefore$ equation is $\lvert z - 3 + 2i \rvert = \sqrt{5}$	M1A1√	2	
	Total		**7**	

The complex numbers z_1 and z_2 are given by

$$z_1 = 1 + \sqrt{3}\,\mathrm{i} \qquad \text{and} \qquad z_2 = \mathrm{i}z_1.$$

(a) (i) Express z_2 in the form $a + \mathrm{i}b$. *(1 mark)*

(ii) Find the modulus and argument of z_2. *(2 marks)*

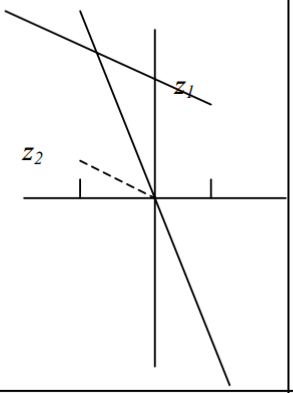
(b) Label the points representing z_1 and z_2 on an Argand diagram. *(1 mark)*

(c) On the **same** Argand diagram, sketch the locus of points z satisfying:

(i) $|z - z_1| = |z - z_2|$; *(2 marks)*

(ii) $\arg(z - z_1) = \arg z_2$. *(2 marks)*

2 (a)(i)	$\mathrm{i}z_1 = -\sqrt{3} + \mathrm{i} = z_2$	B1	1	
(ii)	$\lvert z_2\rvert = 2$, $\arg z_2 = \frac{5\pi}{6}$	B1B1	2	condone 150° accept 2.62 radians
(b)	Points z_1 and z_2 plotted	B1F	1	
(c)(i)	Perpendicular bisector	B1F		
	Through (0,0)	B1	2	
(ii)	Half line through z_1	B1		
	Parallel to Oz_2	B1	2	
	Total		**8**	



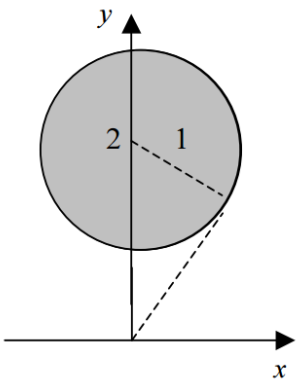
(a) Shade, on an Argand diagram, the region in which

$$|z - 2\mathrm{i}| \leqslant 1.$$ *(4 marks)*

(b) Find the greatest and least values of the argument of complex numbers z satisfying

$$|z - 2\mathrm{i}| \leqslant 1,$$

giving your answers in terms of π. *(4 marks)*

Q	Solution	Marks	Total	Comments
3 (a)				
	Circle	B1		
	Centre correct	B1		
	Radius correct	B1		
	Shading correct	B1	4	Must be a circle for any of these marks
(b)	$\sin\alpha = \frac{1}{2}$	M1		
	$\alpha = \frac{\pi}{6}$	A1		
	least argument $\frac{\pi}{3}$	A1F		If answers or working are given in degrees, deduct 1 mark
	greatest argument $\frac{2\pi}{3}$	A1F	4	
	Total		**8**	