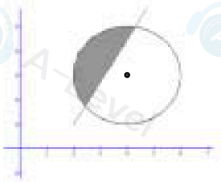
Question	Answer	Marks	Guidance
5(a)	Show a circle with centre -2	**B1**	
	Show a circle with radius 2 and centre not the origin	**B1**	
	Show the line $y = 1$	**B1**	
	Shade the correct region	**B1**	
		4	
5(b)	Identify the correct point and carry out a correct method to find the argument	**M1**	
	Obtain answer $\frac{11}{12}\pi$	**A1**	2.88 radians or 165°.
		2	

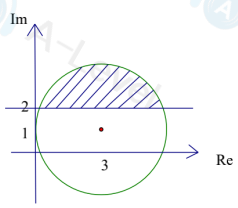
Question	Answer	Marks	Guidance
6(a)	Show a circle centre (4, 3) Allow dashes for coordinates on axes	**B1**	Note full circle is not required but must show centre and include relevant arc.
	Show a circle with radius 2. Can be implied by at least two of the points (2, 3), (6, 3), (4, 1) and (4, 5) being correct	**B1FT**	FT centre not at the origin.
	Point representing (2, 1)	**B1**	Half-line or 'correct' full line extending into the third quadrant implies point (2, 1).
	Show a half-line at their (2, 1) at an angle of $\frac{1}{3}\pi$, cutting top of circle between $x = 3$ and $x = 5$	**B1FT**	FT the point (±2, ±1) or (±1, ±2).
	Shade the correct region Needs correct half-line or "correct" full line extending into the third quadrant **AND** correct circle	**B1**	
		5	
6(b)	Carry out a correct method for finding the greatest value of arg z in the correct region in (a)	**M1**	E.g. $\sin^{-1}(2/\sqrt{(25)}) + \tan^{-1}(3/4)$ or $\sin^{-1}(2/\sqrt{(25)}) + \sin^{-1}(3/5)$. Or, e.g., substitute $y = kx$ in circle equation, solve when discriminant = 0, to get $\tan^{-1}\left(\frac{6+\sqrt{21}}{6}\right)$.
	Obtain answer 1.06, or 1.05 or 1.055 or 1.056 or 60.4° or 60.5°	**A1**	The marks in **(b)** are available even if errors in **(a)**. No working seen scores 0/2 marks.
		2	

4 (a)	$\log_{10} N = 2 \Rightarrow N = 100$	B1
		(1)
(b)	$\log_{10} N = 0.35t + 2 \Rightarrow N = 10^{0.35t+2}$	M1
	$\Rightarrow N = 10^{0.35t} \times 10^2$	dM1
	$\Rightarrow N = 100 \times 2.24^t$	A1
		(3)
(c)	Rate of growth at 5 hours is $\frac{dN}{dt} = 100 \times \ln 2.24 \times 2.24^5$	M1
	Allow an answer in the range 4530 to 4550 (bacteria per hour)	A1
		(2)
		Total 6

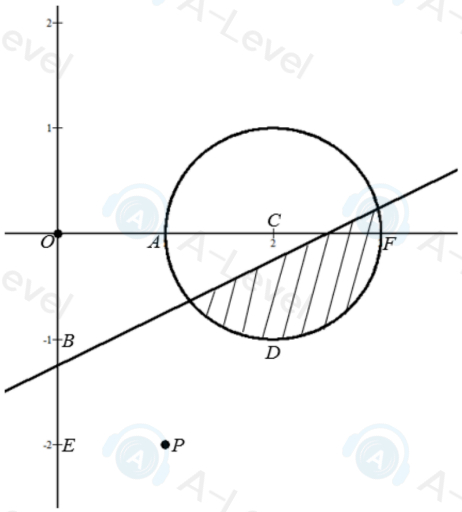
1	$3\tan^2\theta+7\sec\theta-3=0\Rightarrow 3\left(\sec^2\theta-1\right)+7\sec\theta-3=0$	M1
	$3\sec^2\theta+7\sec\theta-6=0$	A1
	$(3\sec\theta-2)(\sec\theta+3)=0\Rightarrow\sec\theta=...\Rightarrow\cos\theta=...$	dM1
	$\theta=109.5°, 250.5°$	A1, A1
		(5)

Question	Answer	Marks	Guidance
3	Square $x + iy$ obtaining three terms when simplified and equate real and imaginary parts to 24 and −7 respectively	**M1**	Having used $i^2 = -1$.
	Obtain equations $x^2 - y^2 = 24$ and $2xy = -7$	**A1**	Allow $2xyi = -7i$.
	Eliminate one variable by correct method and find a horizontal equation in the other	**M1**	All powers of x or y are positive and are in the numerator.
	Obtain $4x^4 - 96x^2 - 49 = 0$ or $4y^4 + 96y^2 - 49 = 0$ or 3-term equivalents	**A1**	
	Obtain answers $\frac{7\sqrt{2}}{2}-\frac{\sqrt{2}}{2}i$ and $-\frac{7\sqrt{2}}{2}+\frac{\sqrt{2}}{2}i$ or exact equivalents and no others	**A1**	E.g. $\pm\left(\frac{7\sqrt{2}}{2}-\frac{\sqrt{2}}{2}i\right)$, but not $\pm\left(\frac{7\sqrt{2}}{2}\mp\frac{\sqrt{2}}{2}i\right)$ or $\left(\pm\frac{7\sqrt{2}}{2}\mp\frac{\sqrt{2}}{2}i\right)$. Allow coordinates or $x = ..., y = \ldots$ paired correctly. ISW converting to different form. Must simplify $\sqrt{49}$.
		5	

Question	Answer	Marks	Guidance
6	Use quadratic formula to solve for z	**M1**	**SC M1**: For substitution of $x + iy$ and multiplying out.
	Use $i^2 = -1$ throughout	**M1**	**SC M1**: Use $i^2 = -1$ throughout.
	Obtain correct answer in any form	**A1**	**SC A1**: For two correct equations $x^2 - y^2 + 6xy - 2x + y = 0$ and $-3\left(x^2 - y^2\right) + 2xy - x - 2y + 1 = 0$.
	Multiply numerator and denominator by (1 + 3i), or equivalent	**M1**	
	Obtain final answer, e.g. $-\frac{1}{2}+\frac{1}{2}i$	**A1**	
	Obtain second final answer, e.g. $\frac{2}{5}+\frac{1}{5}i$	**A1**	
		6	

Question	Answer	Marks	Guidance
3	Show a circle with centre $3 + i$	**B1**	Must be some evidence of scale on both axes or centre stated as 3 + i or (3, 1).
	Show a circle with radius 3 and centre not at the origin	**B1**	Must be some evidence that radius = 3 or stated $r = 3$
	Show the line $y = 2$	**B1**	Line $y = 2$ can be represented by 2 or correct dashes.
	Shade the correct region	**B1**	Line and circle must be correct.
		**4**	Scales may be replaced by dashes on axes for all marks. Correct figure, with no scale on either axis then allow 1/3 and the B1 for correct shaded region Max 2/4. If B0 above for line but relatively correct position then B1 for correct shaded region Max 3/4. Re and Im axes interchanged but clearly labelled, allow **SCB1** for centre and radius of circle correct and **SCB1** for line and shading correct Max 2/4.

Question Number	Scheme	Marks
2(a)	$\text{ff}(6)=\text{f}\left("\frac{9}{2}"\right)=\frac{"\frac{9}{2}"+3}{"\frac{9}{2}"-4}=\ldots;\ =15$	M1; A1
		(2)
(b)	$\text{f}^{-1}(x)=\frac{4x+3}{x-1}$	M1A1
	$x\in\mathbb{R},\ x\neq 1$	B1
		(3)
(c)	E.g. $\left(\frac{x+3}{x-4}\right)^2+5=7$ or $\frac{a+3}{a-4}=(\pm)\sqrt{7-5}$	M1
	$\Rightarrow x^2-22x+23=0\Rightarrow x=\ldots$ or $(a+3)=(\pm)\sqrt{2}(a-4)\Rightarrow a=\ldots$	dM1
	$(a=)11+7\sqrt{2}$ oe	A1
		(3)

Question	Answer	Marks	Guidance
2	Shade the correct region. Dependent on all previous marks, except in case 3 below, and the perpendicular must cut axes between *CF* and *BE,* but not actually through *C* or *F* and not through *B* or *E* Scale can be implied by dashes 1 Scale only on *y*-axis and $2OA = OC$ B1, B1FT, B1, B1FT, B1 2 Scale only on *x*-axis and $2OB = OE$ B1, B1FT, B1, B1FT, B1 3 No scale on either axis, but $2OA = OC$ then $2OB = OE$ B0, B1FT, B0, B1FT, B1	**B1**	
		5	