1 *EITHER*: State or imply non-modular inequality $(2x-5)^2 > (3(2x+1))^2$, or corresponding quadratic
equation, or pair of linear equations $(2x-5) = \pm 3(2x+1)$ **B1**
Make reasonable solution attempt at a 3-term quadratic, or solve two linear equations for x **M1**
Obtain critical values -2 and $\frac{1}{4}$ **A1**
State final answer $-2 < x < \frac{1}{4}$ **A1**
OR: Obtain critical value $x = -2$ from a graphical method, or by inspection, or by solving a linear
equation or inequality **B1**
Obtain critical value $x = \frac{1}{4}$ similarly **B2**
State final answer $-2 < x < \frac{1}{4}$ **B1** [4]
[Do not condone $\leqslant$ for $<$]

2 State or imply $1 + u = u^2$ **B1**
Solve for u **M1**
Obtain root $\frac{1}{2}(1+\sqrt{5})$, or decimal in [1.61, 1.62] **A1**
Use correct method for finding x from a positive root **M1**
Obtain $x = 0.438$ and no other answer **A1** [5]

3 Use $\tan(A \pm B)$ and obtain an equation in $\tan\theta$ and $\tan\phi$ **M1***
Substitute throughout for $\tan\theta$ or for $\tan\phi$ **dep M1***
Obtain $3\tan^2\theta - \tan\theta - 4 = 0$ or $3\tan^2\phi - 5\tan\phi - 2 = 0$, or 3-term equivalent **A1**
Solve a 3-term quadratic and find an angle **M1**
Obtain answer $\theta = 135°$, $\phi = 63.4°$ **A1**
Obtain answer $\theta = 53.1°$, $\phi = 161.6°$ **A1** [6]
[Treat answers in radians as a misread. Ignore answers outside the given interval.]
[SR: Two correct values of θ (or ϕ) score A1; then A1 for both correct θ, ϕ pairs.]

4 **(i)** Evaluate, or consider the sign of, $x^3 - x^2 - 6$ for two integer values of x, or equivalent **M1**
Obtain the pair $x = 2$ and $x = 3$, with no errors seen **A1** [2]

(ii) State a suitable equation, e.g. $x = \sqrt{(x + (6/x))}$ **B1**
Rearrange this as $x^3 - x^2 - 6 = 0$, or work *vice versa* **B1** [2]

(iii) Use the iterative formula correctly at least once **M1**
Obtain final answer 2.219 **A1**
Show sufficient iterates to 5 d.p. to justify 2.219 to 3 d.p., or show there is a sign change in the interval (2.2185, 2.2195) **A1** [3]

5	**(i)**	State or imply that the derivative of e^{-2x} is $-2e^{-2x}$	**B1**	
		Use product or quotient rule	**M1**	
		Obtain correct derivative in any form	**A1**	
		Use Pythagoras	**M1**	
		Justify the given form	**A1**	[5]
	(ii)	Fully justify the given statement	**B1**	[1]
	(iii)	State answer $x = \frac{1}{4}\pi$	**B1**	[1]
6	**(i)**	Substitute $x = -1$, equate to zero and simplify at least as far as $-8 + a - b - 1 = 0$	**B1**	
		Substitute $x = -\frac{1}{2}$ and equate the result to 1	**M1**	
		Obtain a correct equation in any form, e.g. $-1 + \frac{1}{4}a - \frac{1}{2}b - 1 = 1$	**A1**	
		Solve for *a* or for *b*	**M1**	
		Obtain $a = 6$ and $b = -3$	**A1**	[5]
	(ii)	Commence division by $(x + 1)$ reaching a partial quotient $8x^2 + kx$	**M1**	
		Obtain quadratic factor $8x^2 - 2x - 1$	**A1**	
		Obtain factorisation $(x+1)(4x+1)(2x-1)$	**A1**	[3]
		[The M1 is earned if inspection reaches an unknown factor $8x^2 + Bx + C$ and an equation in *B* and/or *C*, or an unknown factor $Ax^2 + Bx - 1$ and an equation in *A* and/or *B*.] [If linear factors are found by the factor theorem, give B1B1 for $(2x - 1)$ and $(4x + 1)$, and B1 for the complete factorisation.]		
7	**(i)**	Use correct method to form a vector equation for *AB*	**M1**	
		Obtain a correct equation, e.g. $\mathbf{r} = \mathbf{i} + 2\mathbf{j} + \lambda(2\mathbf{i} - 2\mathbf{j} + \mathbf{k})$ or $\mathbf{r} = 3\mathbf{i} + \mathbf{k} + \mu(2\mathbf{i} - 2\mathbf{j} + \mathbf{k})$	**A1**	[2]
	(ii)	Using a direction vector for *AB* and a relevant point, obtain an equation for *m* in any form	**M1**	
		Obtain answer $2x - 2y + z = 4$, or equivalent	**A1**	[2]
	(iii)	Express general point of *AB* in component form, e.g. $(1 + 2\lambda, 2 - 2\lambda, \lambda)$ or $(3 + 2\mu, -2\mu, 1 + \mu)$	**B1√**	
		Substitute in equation of *m* and solve for λ or for μ	**M1**	
		Obtain final answer $\frac{7}{3}\mathbf{i} + \frac{2}{3}\mathbf{j} + \frac{2}{3}\mathbf{k}$ for the position vector of *N*, from $\lambda = \frac{2}{3}$ or $\mu = -\frac{1}{3}$	**A1**	
		Carry out a correct method for finding *CN*	**M1**	
		Obtain the given answer $\sqrt{13}$	**A1**	[5]
		[The f.t. is on the direction vector for *AB*.]		

8		Separate variables and integrate one side	**B1**	
		Obtain term $\ln(x+2)$	**B1**	
		Use cos $2A$ formula to express $\sin^2 2\theta$ in the form $a + b\cos 4\theta$	**M1**	
		Obtain correct form $(1-\cos 4\theta)/2$, or equivalent	**A1**	
		Integrate and obtain term $\frac{1}{2}\theta - \frac{1}{8}\sin 4\theta$, or equivalent	**A1**√	
		Evaluate a constant, or use $\theta = 0$, $x = 0$ as limits in a solution containing terms $c\ln(x+2), d\sin(4\theta), e\theta$	**M1**	
		Obtain correct solution in any form, e.g. $\ln(x+2) = \frac{1}{2}\theta - \frac{1}{8}\sin 4\theta + \ln 2$	**A1**	
		Use correct method for solving an equation of the form $\ln(x+2) = f$	**M1**	
		Obtain answer $x = 0.962$	**A1**	[9]
9	**(i)**	Show u in a relatively correct position	**B1**	
		Show u^* in a relatively correct position	**B1**	
		Show $u^* - u$ in a relatively correct position	**B1**	
		State or imply that *OABC* is a parallelogram	**B1**	[4]
	(ii)	*EITHER*: Substitute for u and multiply numerator and denominator by 3 + i, or equivalent	**M1**	
		Simplify the numerator to 8 + 6i or the denominator to 10	**A1**	
		Obtain final answer $\frac{4}{5} + \frac{3}{5}\mathrm{i}$, or equivalent	**A1**	
		OR: Substitute for u, obtain two equations in x and y and solve for x or for y	**M1**	
		Obtain $x = \frac{4}{5}$ or $y = \frac{3}{5}$, or equivalent	**A1**	
		Obtain final answer $\frac{4}{5} + \frac{3}{5}\mathrm{i}$, or equivalent	**A1**	[3]
	(iii)	State or imply $\arg(u^*/u) = \tan^{-1}(\frac{3}{4})$	**B1**	
		Substitute exact arguments in $\arg(u^*/u) = \arg u^* - \arg u$	**M1**	
		Fully justify the given statement using exact values	**A1**	[3]
10	**(i)**	Use the quotient rule	**M1**	
		Obtain correct derivative in any form	**A1**	
		Equate derivative to zero and solve for x	**M1**	
		Obtain answer $x = \sqrt[3]{2}$, or exact equivalent	**A1**	[4]
	(ii)	State or imply indefinite integral is of the form $k\ln(1+x^3)$	**M1**	
		State indefinite integral $\frac{1}{3}\ln(1+x^3)$	**A1**	
		Substitute limits correctly in an integral of the form $k\ln(1+x^3)$	**M1**	
		State or imply that the area of R is equal to $\frac{1}{3}\ln(1+p^3) - \frac{1}{3}\ln 2$, or equivalent	**A1**	
		Use a correct method for finding p from an equation of the form $\ln(1+p^3) = a$ or $\ln((1+p^3)/2) = b$	**M1**	
		Obtain answer $p = 3.40$	**A1**	[2]