1 *EITHER*: State or imply non-modular inequality $(x-3)^2 > (2(x+1))^2$, or corresponding quadratic equation, or pair of linear equations $(x-3) = \pm 2(x+1)$ — B1
Make reasonable solution attempt at a 3-term quadratic, or solve two linear equations — M1
Obtain critical values -5 and $\frac{1}{3}$ — A1
State answer $-5 < x < \frac{1}{3}$ — A1

OR: Obtain the critical value $x = -5$ from a graphical method, or by inspection, or by solving a linear equation or inequality — B1
Obtain the critical value $x = \frac{1}{3}$ similarly — B2
State answer $-5 < x < \frac{1}{3}$ — B1 [4]
[Do not condone ≤ for <; accept 0.33 for $\frac{1}{3}$.]

2 **(i)** State or imply $3\ln y = \ln A + 2x$ at any stage — B1
State gradient is $\frac{2}{3}$, or equivalent — B1 [2]

(ii) Substitute $x = 0$, $\ln y = 0.5$ and solve for A — M1
Obtain $A = 4.48$ — A1 [2]

3 Attempt to use $\tan(A \pm B)$ formula and obtain an equation in $\tan x$ — M1
Obtain 3-term quadratic $2\tan^2 x + 3\tan x - 1 = 0$, or equivalent — A1
Solve a 3-term quadratic and find a numerical value of x — M1
Obtain answer 15.7° — A1
Obtain answer 119.3° and no others in the given interval — A1 [5]
[Ignore answers outside the given interval. Treat answers in radians, 0.274 and 2.08, as a misread.]

4 Separate variables correctly — B1
Obtain term $k\ln(4-x^2)$, or terms $k_1\ln(2-x) + k_2\ln(2+x)$ — B1
Obtain term $-2\ln(4-x^2)$, or $-2\ln(2-x) - 2\ln(2+x)$, or equivalent — B1
Obtain term t, or equivalent — B1
Evaluate a constant or use limits $x = 1$, $t = 0$ in a solution containing terms $a\ln(4-x^2)$ and bt or terms $c\ln(2-x)$, $d\ln(2+x)$ and bt — M1
Obtain correct solution in any form, e.g. $-2\ln(4-x^2) = t - 2\ln 3$ — A1
Rearrange and obtain $x^2 = 4 - 3\exp(-\frac{1}{2}t)$, or equivalent (allow use of $2\ln 3 = 2.20$) — A1 [7]

5 **(i)** State derivative $-e^{-x} - (-2)e^{-2x}$, or equivalent — B1 + B1
Equate derivative to zero and solve for x — M1
Obtain $p = \ln 2$, or exact equivalent — A1 [4]

(ii) State indefinite integral $-e^{-x} - (-\frac{1}{2})e^{-2x}$, or equivalent — B1 + B1
Substitute limits $x = 0$ and $x = p$ correctly — M1
Obtain given answer following full and correct working — A1 [4]

6	(i)	Use correct quotient or product rule	M1	
		Obtain correct derivative in any form, e.g. $\frac{1}{x(x+1)} - \frac{\ln x}{(x+1)^2}$	A1	
		Equate derivative to zero and obtain the given equation correctly	A1	
		Consider the sign of $x - \frac{(x+1)}{\ln x}$ at $x = 3$ and $x = 4$, or equivalent	M1	
		Complete the argument with correct calculated values	A1	[5]
	(ii)	Use the iterative formula correctly at least once, using or reaching a value in the interval (3, 4)	M1	
		Obtain final answer 3.59	A1	
		Show sufficient iterations to at least 4 d.p. to justify its accuracy to 2 d.p., or show there is a sign change in the interval (3.585, 3.595)	A1	[3]
7	(i)	Use correct cos(*A* + *B*) formula to express $\cos 3\theta$ in terms of trig functions of 2θ and θ	M1	
		Use correct trig formulae and Pythagoras to express $\cos 3\theta$ in terms of $\cos\theta$	M1	
		Obtain a correct expression in terms of $\cos\theta$ in any form	A1	
		Obtain the given identity correctly	A1	[4]
		[SR: Give M1 for using correct formulae to express RHS in terms of $\cos\theta$ and $\cos 2\theta$, then M1A1 for expressing in terms of either only $\cos 3\theta$ and $\cos\theta$, or only $\cos 2\theta$, $\sin 2\theta$, $\cos\theta$, and $\sin\theta$, and A1 for obtaining the given identity correctly.]		
	(ii)	Use identity and integrate, obtaining terms $\frac{1}{4}(\frac{1}{3}\sin 3\theta)$ and $\frac{1}{4}(3\sin\theta)$, or equivalent	B1 + B1	
		Use limits correctly in an integral of the form $k\sin 3\theta + l\sin\theta$	M1	
		Obtain answer $\frac{2}{3} - \frac{3}{8}\sqrt{3}$, or any exact equivalent	A1	[4]
8	(a)	*EITHER*: Substitute $1 + i\sqrt{3}$, attempt complete expansions of the x^3 and x^2 terms	M1	
		Use $i^2 = -1$ correctly at least once	B1	
		Complete the verification correctly	A1	
		State that the other root is $1 - i\sqrt{3}$	B1	
		*OR*1: State that the other root is $1 - i\sqrt{3}$	B1	
		State quadratic factor $x^2 - 2x + 4$	B1	
		Divide cubic by 3-term quadratic reaching partial quotient $2x + k$	M1	
		Complete the division obtaining zero remainder	A1	
		*OR*2: State factorisation $(2x+3)(x^2 - 2x + 4)$, or equivalent	B1	
		Make reasonable solution attempt at a 3-term quadratic and use $i^2 = -1$	M1	
		Obtain the root $1 + i\sqrt{3}$	A1	
		State that the other root is $1 - i\sqrt{3}$	B1	[4]
	(b)	Show point representing $1 + i\sqrt{3}$ in relatively correct position on an Argand diagram	B1	
		Show circle with centre at $1 + i\sqrt{3}$ and radius 1	B1√	
		Show line for arg $z = \frac{1}{3}\pi$ making $\frac{1}{3}\pi$ with the real axis	B1	
		Show line from origin passing through centre of circle, or the diameter which would contain the origin if produced	B1	
		Shade the relevant region	B1√	[5]

9	**(i)**	State or imply partial fractions of the form $\dfrac{A}{1-2x}+\dfrac{B}{2+x}+\dfrac{C}{(2+x)^2}$	B1	
		Use any relevant method to determine a constant	M1	
		Obtain one of the values $A = 1$, $B = 1$, $C = -2$	A1	
		Obtain a second value	A1	
		Obtain the third value	A1	[5]
		[The form $\dfrac{A}{1-2x}+\dfrac{Dx+E}{(2+x)^2}$, where $A = 1$, $D = 1$, $E = 0$, is acceptable scoring B1M1A1A1A1 as above.]		
	(ii)	Use correct method to obtain the first two terms of the expansion of $(1-2x)^{-1}$, $(2+x)^{-1}$, $(2+x)^{-2}$, $(1+\frac{1}{2}x)^{-1}$, or $(1+\frac{1}{2}x)^{-2}$	M1	
		Obtain correct unsimplified expansions up to the term in x^2 of each partial fraction	A1√ + A1√ + A1√	
		Obtain answer $1+\dfrac{9}{4}x+\dfrac{15}{4}x^2$, or equivalent	A1	[5]
		[Symbolic binomial coefficients, e.g. $\begin{pmatrix}-1\\1\end{pmatrix}$, are not sufficient for the M1. The f.t. is on *A*, *B*, *C*.]		
		[For the *A*, *D*, *E* form of partial fractions, give M1A1√A1√ for the expansions then, if $D \neq 0$, M1 for multiplying out fully and A1 for the final answer.]		
		[In the case of an attempt to expand $(4+5x-x^2)(1-2x)^{-1}(2+x)^{-2}$, give M1A1A1 for the expansions, M1 for multiplying out fully, and A1 for the final answer.]		
		[SR: If *B* or *C* omitted from the form of fractions, give B0M1A0A0A0 in **(i)**; M1A1√A1√ in **(ii)**.]		
		[SR: If *D* or *E* omitted from the form of fractions, give B0M1A0A0A0 in **(i)**; M1A1√A1√ in **(ii)**.]		
10	**(i)**	Express general point of the line in component form, e.g. $(2+\lambda, -1+2\lambda, -4+2\lambda)$	B1	
		Substitute in plane equation and solve for λ	M1	
		Obtain position vector $4\mathbf{i} + 3\mathbf{j}$, or equivalent	A1	[3]
	(ii)	State or imply a correct vector normal to the plane, e.g. $3\mathbf{i} - \mathbf{j} + 2\mathbf{k}$	B1	
		Using the correct process, evaluate the scalar product of a direction vector for *l* and a normal for *p*	M1	
		Using the correct process for the moduli, divide the scalar product by the product of the moduli and evaluate the inverse cosine or inverse sine of the result	M1	
		Obtain answer 26.5° (or 0.462 radians)	A1	[4]
	(iii)	*EITHER*: State $a + 2b + 2c = 0$ or $3a - b + 2c = 0$	B1	
		Obtain two relevant equations and solve for one ratio, e.g. $a : b$	M1	
		Obtain $a : b : c = 6 : 4 : -7$, or equivalent	A1	
		Substitute coordinates of a relevant point in $6x + 4y - 7z = d$ and evaluate d	M1	
		Obtain answer $6x + 4y - 7z = 36$, or equivalent	A1	
		*OR*1: Attempt to calculate vector product of relevant vectors, e.g. $(\mathbf{i} + 2\mathbf{j} + 2\mathbf{k}) \times (3\mathbf{i} - \mathbf{j} + 2\mathbf{k})$	M1	
		Obtain two correct components of the product	A1	
		Obtain correct product, e.g. $6\mathbf{i} + 4\mathbf{j} - 7\mathbf{k}$	A1	
		Substitute coordinates of a relevant point in $6x + 4y - 7z = d$ and evaluate d	M1	
		Obtain answer $6x + 4y - 7z = 36$, or equivalent	A1	
		*OR*2: Attempt to form 2-parameter equation with relevant vectors	M1	
		State a correct equation, e.g. $\mathbf{r} = 2\mathbf{i} - \mathbf{j} - 4\mathbf{k} + \lambda(\mathbf{i} + 2\mathbf{j} + 2\mathbf{k}) + \mu(3\mathbf{i} - \mathbf{j} + 2\mathbf{k})$	A1	
		State three equations in x, y, z, λ, μ	A1	
		Eliminate λ and μ	M1	
		Obtain answer $6x + 4y - 7z = 36$, or equivalent	A1	[5]