1	Either:	Obtain $1+\frac{1}{3}kx$, where $k = \pm 6$ or ± 1	M1	
		Obtain $1 - 2x$	A1	
		Obtain $-4x^2$	A1	
		Obtain $-\frac{40}{3}x^3$ or equivalent	A1	
	Or:	Differentiate expression to obtain form $k(1-6x)^{-\frac{2}{3}}$ and evaluate f(0) and f′(0)	M1	
		Obtain $f'(x) = -2(1-6x)^{-\frac{2}{3}}$ and hence the correct first two terms $1 - 2x$	A1	
		Obtain $f''(x) = -8(1-6x)^{-\frac{5}{3}}$ and hence $-4x^2$	A1	
		Obtain $f'''(x) = -80(1-6x)^{-\frac{8}{3}}$ and hence $-\frac{40}{3}x^3$ or equivalent	A1	[4]
2	(i)	Obtain $\frac{k\cos 2x}{1+\sin 2x}$ for any non-zero constant k	M1	
		Obtain $\frac{2\cos 2x}{1+\sin 2x}$	A1	[2]
	(ii)	Use correct quotient or product rule	M1	
		Obtain $\frac{x\sec^2 x - \tan x}{x^2}$ or equivalent	A1	[2]
3	(i)	Obtain $\pm\begin{pmatrix}3\\-4\\6\end{pmatrix}$ as normal to plane	B1	
		Form equation of p as $3x - 4y + 6z = k$ or $-3x + 4y - 6z = k$ and use relevant point to find k	M1	
		Obtain $3x - 4y + 6z = 80$ or $-3x + 4y - 6z = -80$	A1	[3]
	(ii)	State the direction vector $\begin{pmatrix}0\\1\\0\end{pmatrix}$ or equivalent	B1	
		Carry out correct process for finding scalar product of two relevant vectors	M1	
		Use correct complete process with moduli and scalar product and evaluate $\sin^{-1}$ or $\cos^{-1}$ of result	M1	
		Obtain 30.8° or 0.538 radians	A1	[4]

4	**(i)**	Verify that $-96 + 100 + 8 - 12 = 0$	B1	
		Attempt to find quadratic factor by division by $(x + 2)$, reaching a partial quotient $12x^2 + kx$, inspection or use of an identity	M1	
		Obtain $12x^2 + x - 6$	A1	
		State $(x + 2)(4x + 3)(3x - 2)$	A1	[4]
		[The M1 can be earned if inspection has unknown factor $Ax^2 + Bx - 6$ and an equation in A and/or B or equation $12x^2 + Bx + C$ and an equation in B and/or C.]		
	(ii)	State $3^y = \frac{2}{3}$ and no other value	B1	
		Use correct method for finding y from equation of form $3^y = k$, where $k > 0$	M1	
		Obtain -0.369 and no other value	A1	[3]
5	**(i)**	Use at least one of $e^{2x} = 9$, $e^y = 2$ and $e^{2y} = 4$	B1	
		Obtain given result $58 + 2k = c$ **AG**	B1	[2]
	(ii)	Differentiate left-hand side term by term, reaching $ae^{2x} + be^y\frac{dy}{dx} + ce^{2y}\frac{dy}{dx}$	M1	
		Obtain $12e^{2x} + ke^y\frac{dy}{dx} + 2e^{2y}\frac{dy}{dx}$	A1	
		Substitute (ln 3, ln 2) in an attempt involving implicit differentiation at least once, where RHS = 0	M1	
		Obtain $108 - 12k - 48 = 0$ or equivalent	A1	
		Obtain $k = 5$ and $c = 68$	A1	[5]
6	**(i)**	State or imply area of segment is $\frac{1}{2}r^2\theta - \frac{1}{2}r^2\sin\theta$ or $50\theta - 50\sin\theta$	B1	
		Attempt to form equation from area of segment = $\frac{1}{5}$ of area of circle, or equivalent	M1	
		Confirm given result $\theta = \frac{2}{5}\pi + \sin\theta$	A1	[3]
	(ii)	Use iterative formula correctly at least once	M1	
		Obtain value for θ of 2.11	A1	
		Show sufficient iterations to justify value of θ or show sign change in interval (2.105, 2.115)	A1	
		Use correct trigonometry to find an expression for the length of AB	M1	
		e.g. $20\sin 1.055$ or $\sqrt{200 - 200\cos 2.11}$		
		Hence 17.4	A1	[5]
		$[2.1 \to 2.1198 \to 2.1097 \to 2.1149 \to 2.1122]$		

7	**(i)**	State or imply $dx = 2t\,dt$ or equivalent	B1	
		Express the integral in terms of x and dx	M1	
		Obtain given answer $\int_1^5 (2x-2)\ln x\,dx$, including change of limits **AG**	A1	[3]
	(ii)	Attempt integration by parts obtaining $(ax^2 + bx)\ln x \pm \int (ax^2+bx)\frac{1}{x}dx$ or equivalent	M1	
		Obtain $(x^2 - 2x)\ln x - \int (x^2 - 2x)\frac{1}{x}dx$ or equivalent	A1	
		Obtain $(x^2 - 2x)\ln x - \frac{1}{2}x^2 + 2x$	A1	
		Use limits correctly having integrated twice	M1	
		Obtain 15 ln 5 – 4 or exact equivalent	A1	[5]
		[Equivalent for M1 is $(2x-2)(ax\ln x + bx) - \int (ax\ln x + bx)\,2dx$]		
8	**(i)**	Either: Multiply numerator and denominator by (1 – 2i), or equivalent	M1	
		Obtain –3i	A1	
		State modulus is 3	A1	
		Refer to u being on negative imaginary axis or equivalent and confirm argument as $-\frac{1}{2}\pi$	A1	
		Or: Using correct processes, divide moduli of numerator and denominator	M1	
		Obtain 3	A1	
		Subtract argument of denominator from argument of numerator	M1	
		Obtain $-\tan^{-1}\frac{1}{2} - \tan^{-1}2$ or $-0.464 - 1.107$ and hence $-\frac{1}{2}\pi$ or -1.57	A1	[4]
	(ii)	Show correct half-line from u at angle $\frac{1}{4}\pi$ to real direction	B1	
		Use correct trigonometry to find required value	M1	
		Obtain $\frac{3}{2}\sqrt{2}$ or equivalent	A1	[3]
	(iii)	Show, or imply, locus is a circle with centre $(1 + i)u$ and radius 1	M1	
		Use correct method to find distance from origin to furthest point of circle	M1	
		Obtain $3\sqrt{2} + 1$ or equivalent	A1	[3]

9	**(i)**	Express $\cos 4\theta$ as $2\cos^2 2\theta - 1$ or $\cos^2 2\theta - \sin^2 2\theta$ or $1 - 2\sin^2 2\theta$	B1	
		Express $\cos 4\theta$ in terms of $\cos\theta$	M1	
		Obtain $8\cos^4\theta - 8\cos^2\theta + 1$	A1	
		Use $\cos 2\theta = 2\cos^2\theta - 1$ to obtain given answer $8\cos^4\theta - 3$ **AG**	A1	[4]
	(ii) (a)	State or imply $\cos^4\theta = \frac{1}{2}$	B1	
		Obtain 0.572	B1	
		Obtain –0.572	B1	[3]
	(b)	Integrate and obtain form $k_1\theta + k_2\sin 4\theta + k_3\sin 2\theta$	M1	
		Obtain $\frac{3}{8}\theta + \frac{1}{32}\sin 4\theta + \frac{1}{4}\sin 2\theta$	A1	
		Obtain $\frac{3}{32}\pi + \frac{1}{4}$ following completely correct work	A1	[3]
10	**(i)**	Separate variables correctly and integrate of at least one side	M1	
		Carry out an attempt to find A and B such that $\frac{1}{N(1800-N)} \equiv \frac{A}{N} + \frac{B}{1800-N}$, or equivalent	M1	
		Obtain $\frac{2}{N} + \frac{2}{1800-N}$ or equivalent	A1	
		Integrates to produce two terms involving natural logarithms	M1	
		Obtain $2\ln N - 2\ln(1800 - N) = t$ or equivalent	A1	
		Evaluate a constant, or use $N = 300$ and $t = 0$ in a solution involving $a\ln N$, $b\ln(1800)$ and ct	M1	
		Obtain $2\ln N - 2\ln(1800 - N) = t - 2\ln 5$ or equivalent	A1	
		Use laws of logarithms to remove logarithms	M1	
		Obtain $N = \frac{1800e^{\frac{1}{2}t}}{5 + e^{\frac{1}{2}t}}$ or equivalent	A1	[9]
	(ii)	State or imply that N approaches 1800	B1	[1]