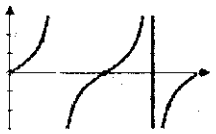
1	(i)	u_1 2, u_2 5, u_3 8	B1	For the correct value of u_1
			B1	For both correct values of u_2 and u_3
		The sequence is an Arithmetic Progression	B1 3	For a correct statement (any mention of arithmetic)
	(ii)	$\frac{1}{2} \times 100 \times (2 \times 2 + 99 \times 3) = 15050$	M1	For correct interpretation of Sigma notation – ie finding the sum of an AP or GP
			M1	For use of correct $\frac{1}{2}n(2a + (n-1)d)$, or equiv, with $n = 100$ and a & d not both 1
			A1 3	For correct value 15050
			6	
2	(i)	$r\theta = 12$, $\frac{1}{2}r^2\theta = 36$	B1	For $r\theta = 12$ stated correctly at any point
			B1 2	For $\frac{1}{2}r^2\theta = 36$ stated correctly at any point
	(ii)	$\frac{1}{2}r \times 12 = 36 \Rightarrow r = 6$	B1	For showing given value correctly
		Hence $\theta = 2$	B1 2	For correct value 2 (or 0.637π)
	(iii)	Segment area is $36 - \frac{1}{2} \times 6^2 \times \sin 2 = 19.6\ \text{cm}^2$	M1*	For use of $A = \frac{1}{2}ab\sin C$, or equivalent
			M1dep*	For attempt at 36 – A
			A1 3	For correct value (rounding to) 19.6
			7	
3	(i)	$\int (2x^2 + 7x + 3)\,dx$	M1	For expanding and integration attempt
		$= \frac{2}{3}x^3 + \frac{7}{2}x^2 + 3x + c$	A1	For at least one term correct
			A1	For all three terms correct
			B1 4	For addition of arbitrary constant, and no $\int$ or dx
	(ii)	$\left[\frac{2}{3}x^3 + \frac{7}{2}x^2 + 3x\right]_0^1$	M1	For integral of the form $kx^{\frac{1}{2}}$
		$= 6$	M1	For evaluating at least F(0), following attempt at integration
			A1 3	For final answer of 6 only
			7	
4	(i)	$\cos BCA = \frac{5^2+6^2-7^2}{2\times5\times6} = -\frac{1}{5}$	M1	For relevant use of the correct cosine formula
			M1	For attempt to rearrange correct formula
			A1	For obtaining the given value correctly
		So $\sin BCA = \frac{2}{5}\sqrt{2} = 0.9428\ldots$	B1	For correct answer for sin BCA in any form OR
			M1	For substituting cos BCA = $-\frac{1}{5}$
			M1	For attempt at evaluation
			A1	For full verification
			B1 4	For correct answer for sin BCA in any form
	(ii)	Angles BCA and CAD are equal	B1	For stating, using or implying the equal angles
		So $\sin ADC = \frac{5}{6}\sin x$, $DC = \frac{5}{6} \times \frac{1}{5}\sqrt{5} = \frac{1}{6}\sqrt{5}$	M1	For correct use of the sine rule in Δ ADC (sides must be numerical, angles may still be in letters)
		$\angle ADC = 18.3°$	A1√	
			A1 4	For a correct equation from their value in (i)
			8	For correct answer, from correct working
5	(i)	$f(-1) = 0 \Rightarrow -1 + a + b = 0$	M1	For equating their attempt at f(-1) to 0, or equiv
			A1	For the correct (unsimplified) equation
		$f(3) = 16 \Rightarrow 27 + 3a + b = 16$	M1	For equating their attempt at f(3) to 16, or equiv
			A1	For the correct (unsimplified) equation
		Hence $a = -3$, $b = 2$	A1 5	For both correct values – must follow two correct equations
	(ii)	$f(2) = 8 - 6 + 2 = 0$	B1	For the correct verification (from correct a &

			M1	b)
		Hence $f(x) = (x+1)^2(x-2)$	A1 3	For recognition or use of two linear factors, or full division attempt by either $(x+1)$ or $(x-2)$
			8	For correct third factor (repeated) of $(x+1)$, and full linear factorisation stated
6	(i)	$x^6 + 3x^3 + 3 + \frac{1}{x^3}$	M1	For 4 term binomial attempt or equiv
			A1	For any one (unsimplified) term correct
			A1	For any other (unsimplified) term correct
			A1 4	For full, simplified, expansion correct
	(ii)	$\frac{1}{7}x^7 + \frac{3}{4}x^4 + 3x - \frac{1}{2}x^{-2} + c$	M1	For any correct use of $\frac{x^{n+1}}{n+1}$
			A1√	For any two terms integrated correctly
			M1	For any correct use of x^{n-1} using a negative index
			A1√ 4	For all terms integrated correctly (must have at least 4 terms, including at least 1 negative index)
			8	[No penalty for omission of $+c$ in this part]
7	(i)	$\log_5\left(\frac{15\times20}{12}\right) = \log_5 25 = 2$	M1	For any relevant combination of $\log a \pm \log b$
			A1	For log 25 must follow correct working only
			A1 3	For correct answer 2
	(ii)	Method A $\frac{1}{3}y = 10^{2x}$	M1	For correct division of both sides by 3
		Hence $2x = \log_{10}\left(\frac{1}{3}y\right)$	M1	For relevant use of $a = b^c \Leftrightarrow c = \log_b a$
		i.e. $x = \frac{1}{2}\log_{10}\left(\frac{1}{3}y\right)$	A1	For correct equation involving logs to base 10
			A1 4	For correct answer for x
		Method B $\frac{1}{3}y = 10^{2x}$	M1	For correct division of both sides by 3
		$\log\frac{1}{3}y = \log 10^{2x}$	M1	For taking logs of both sides
		$\log\frac{1}{3}y = 2x\log 10$	A1	For correct linear equation involving logs
		i.e. $x = \frac{1}{2}\log_{10}\left(\frac{1}{3}y\right)$	A1 4	For correct answer for x
		Method C $y = 3\times10^{2x} \Rightarrow \log y = \log 3\times10^{2x}$	M1	For introducing logs throughout
			A1	For correct RHS $\log 3 + \log 10^{2x}$
		$\log y = \log 3 + \log 10^{2x}$	M1	For correct use of $\log a^b = b\log a$
		$\log y = \log 3 + 2x\log 10$	A1 4	For correct answer for x
		i.e. $x = \frac{1}{2}\log_{10}\left(\frac{1}{3}y\right)$		
		Method D	M1	For substituting for y, and separating RHS into at least 2 terms
		$x = a\log(b\times3\times10^{2x})$	M1	For attempting values for a and b
		$x = a\log 3b + a\log 10^{2x}$	A1	For obtaining $a = \frac{1}{2}$
		$x = 2ax\log 10 \Rightarrow 2a = 1 \Rightarrow a = \frac{1}{2}$	A1 4	For obtaining $b = \frac{1}{3}$
		$a\log 3b = 0 \Rightarrow 3b = 1 \Rightarrow b = \frac{1}{3}$	7	
8	(i)	$100\,000 \times 0.9^2 = 72900$	M1	For relevant use of ar^2 or equiv
			A1 2	For the correct answer 72900
	(ii)	$100\,000 \times 0.9^x = 5000$	B1	For a correct equation or inequality
		Hence $x\log 0.9 = \log 0.05$	M1	For complete solution method by logs or trial
		So $x = 28.4$, 28 or 29; or $n = 29.4$, 29 or 30	A1	For correct solution for **their** index – allow integer values either side
		i.e. 30th year / 30 years / year is 2030	A1√ 4	For correctly linking **their** index to date or

					number of years
	(iii)	Total is $\frac{1000(1.09^{n+1}-1)}{1.09-1} = 957609$	M1		For relevant use of $\frac{a(r^n-1)}{1-r}$
			A1√		For correct (unsimplified) statement for their integer n (if no n stated then use their year 2000)
			A1	3	For answer 958000 or better, including decimal
				9	
9	(a)	(i) $\cos \frac{1}{3}\pi = \frac{1}{2}$, $\sqrt{3}$	B1		For any correct exact value
		$\tan \frac{1}{3}\pi = \sqrt{3}$	B1		For any correct exact value
		Hence $2\cos \frac{1}{3}\pi - 2 \times \frac{1}{2}\sqrt{3} \cdot \tan \frac{1}{3}\pi$	B1	3	For correct verification (allow via decimals)
		(ii) 	B1		For correct sketch of either $y = \tan 2x$ or $y = 2\cos x$
			B1		For second correct sketch, with both graphs in proportion (ie 3 points of intersection)
			B1		
		Other roots are $\pi/2$ and $5\pi/6$	B1	4	For one of $\pi/2$ or $5\pi/6$ (or equiv in degrees) For second correct value, and no others in range $0 \leq x < \pi$
	(b)	(i) $0.05(0.1003 + 2(0.2027 + 0.3093) + 0.4228)$ 0.0774	M1		State at least three of tan 0.1, tan 0.2, tan 0.3, tan 0.4
			M1		Substitute numerical values (must be attempt at y-coords, not x-coords) into correct trapezium rule, with h consistent with number of strips
			A1		Obtain $0.05(\tan 0.1 + 2(\tan 0.2 + \tan 0.3) + \tan 0.4)$ or equiv in decimals (SC – award A1 if values are now decimals from using degrees – gives final answer of 0.00131)
			A1	4	Obtain 0.077 or better
		(ii) Overestimate; tops of trapezia above the curve or equiv	B1	1	For correct statement and justification
				12	

Mark Scheme 4723
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