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C2 Paper E – Marking Guide

1.	*(i)*	1, 7, 25, 79	B1	
	(ii)	$7 = a + b$	M1	
		$25 = 7a + b$	A1	
		subtracting, $6a = 18$	M1	
		$a = 3,\ b = 4$	A1	**(5)**
2.	*(i)*	x: 1, 1.5, 2, 2.5, 3		
		$\sqrt{4x-1}$: $\sqrt{3}$, $\sqrt{5}$, $\sqrt{7}$, 3, $\sqrt{11}$	M1	
		area $\approx \frac{1}{2} \times 0.5 \times [\sqrt{3} + \sqrt{11} + 2(\sqrt{5} + \sqrt{7} + 3)]$	B1 M1	
		$= 5.20$ (3sf)	A1	
	(ii)	use more trapezia, each with smaller width	B1	**(5)**
3.	*(i)*	$= 2^6 + 6(2^5)(y) + \binom{6}{2}(2^4)(y^2) + \binom{6}{3}(2^3)(y^3) + \ldots$	M2	
		$= 64 + 192y + 240y^2 + 160y^3 + \ldots$	A2	
	(ii)	let $y = x - x^2$		
		$(2 + x - x^2)^6 = 64 + 192(x - x^2) + 240(x - x^2)^2 + 160(x - x^2)^3 + \ldots$	M1	
		$= 64 + 192(x - x^2) + 240(x^2 - 2x^3 + \ldots) + 160(x^3 + \ldots) + \ldots$	M1	
		$= 64 + 192x + 48x^2 - 320x^3 + \ldots$	A1	**(7)**
4.	*(i)*	max. value = 4	B1	
		when $x = 270$	B1	
	(ii)	$\frac{4}{2 + \sin x} = 3$		
		$2 + \sin x = \frac{4}{3}$	M1	
		$\sin x = -\frac{2}{3}$	A1	
		$x = 180 + 41.8,\ 360 - 41.8$	B1 M1	
		$x = 221.8,\ 318.2$ (1dp)	A1	**(7)**
5.	*(a)*	*(i)* $= 2t$	B1	
		(ii) $t = \log_3 x \Rightarrow x = 3^t$	M1	
		$x = (9^{\frac{1}{2}})^t = 9^{\frac{1}{2}t}$	M1 A1	
		$\therefore\ \log_9 x = \frac{1}{2}t$	A1	
	(b)	$2t - \frac{1}{2}t = 4$		
		$t = \frac{8}{3}$	M1	
		$\log_3 x = \frac{8}{3},\quad x = 3^{\frac{8}{3}} = 18.7$ (3sf)	M1 A1	**(8)**
6.		$y = \int (1 - 4x^{-3})\ dx$	M1	
		$y = x + 2x^{-2} + c$	M1 A2	
		$x = -1,\ y = 0\ \therefore\ 0 = -1 + 2 + c$	M1	
		$c = -1$	A1	
		$y = x + 2x^{-2} - 1$		
		when $x = 2,\ y = 2 + \frac{1}{2} - 1 = \frac{3}{2}$	M1 A1	**(8)**

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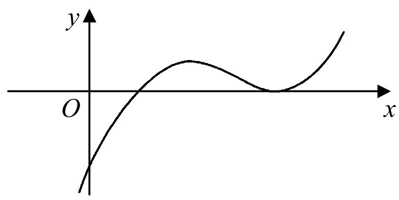
7.	*(i)*	$r = \frac{114}{120} = 0.95$	M1	
		$u_5 = 120 \times (0.95)^4 = 97.74$	M1	
		$\therefore$ 1 hour 38 minutes	A1	
	(ii)	$S_8 = \frac{120[1-(0.95)^8]}{1-0.95}$	M1	
		$= 807.79...$ minutes $\approx$ 13 hours 28 minutes	A1	
	(iii)	$120 \times (0.95)^{n-1} < 60$	M1	
		$(n-1) \lg 0.95 < \lg 0.5$	M1	
		$n > \frac{\lg 0.5}{\lg 0.95} + 1$	A1	
		$n > 14.51 \;\; \therefore$ 15 papers	A1	**(9)**
8.	*(i)*	$= 12 \times (2\pi - \frac{2\pi}{3}) = 16\pi$ cm	M1 A1	
	(ii)	chord $= 2 \times 12 \sin \frac{\pi}{3} = 24 \times \frac{\sqrt{3}}{2} = 12\sqrt{3}$	M1 A1	
		$P = (12 \times \frac{2\pi}{3}) + 12\sqrt{3}$	M1	
		$= 8\pi + 12\sqrt{3} = 4(2\pi + 3\sqrt{3})$ cm $\quad [\, k = 4 \,]$	A1	
	(iii)	area of segment $= (\frac{1}{2} \times 12^2 \times \frac{2\pi}{3}) - (\frac{1}{2} \times 12^2 \times \sin \frac{2\pi}{3})$	M2	
		$= 72(\frac{2\pi}{3} - \frac{\sqrt{3}}{2}) = 88.443$		
		as % of area of circle $= \frac{88.443}{\pi \times 12^2} \times 100\% = 19.6\%$ (1dp)	M1 A1	**(10)**
9.	*(i)*	$f(1) = 1 - 9 + 24 - 16 = 0$	B1	
		$\therefore$ $(x-1)$ is a factor of $f(x)$	B1	
	(ii)	$\begin{array}{r l} & x^2 - 8x + 16 \\ x-1 \,) & x^3 - 9x^2 + 24x - 16 \\ & x^3 - x^2 \\ & -8x^2 + 24x \\ & -8x^2 + 8x \\ & 16x - 16 \\ & 16x - 16 \end{array}$	M1 A1	
		$f(x) = (x-1)(x^2 - 8x + 16)$		
		$f(x) = (x-1)(x-4)^2 \quad [\, p = -1, q = -4 \,]$	M1 A1	
	(iii)		B2	
	(iv)	$= \int_1^4 (x^3 - 9x^2 + 24x - 16)\, dx$		
		$= [\frac{1}{4}x^4 - 3x^3 + 12x^2 - 16x]_1^4$	M1 A2	
		$= [(64 - 192 + 192 - 64) - (\frac{1}{4} - 3 + 12 - 16)]$	M1	
		$= 6\frac{3}{4}$	A1	**(13)**

Total **(72)**

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