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)**

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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)**

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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)**

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4. *(i)* max. value = 4 — B1

when $x = 270$ — B1

(ii) $\dfrac{4}{2 + \sin x} = 3$

$2 + \sin x = \frac{4}{3}$ — M1

$\sin x = -\frac{2}{3}$ — A1

$x = 180 + 41.8,\ 360 - 41.8$ — B1 M1

$x = 221.8,\ 318.2$ (1dp) — A1 **(7)**

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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)**

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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

$= 807.79\ldots$ 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

$n > 14.51 \quad \therefore$ 15 papers A1 **(9)**

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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)**

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9. *(i)* $f(1) = 1 - 9 + 24 - 16 = 0$ B1

$\therefore \ (x-1)$ is a factor of $f(x)$ B1

(ii)

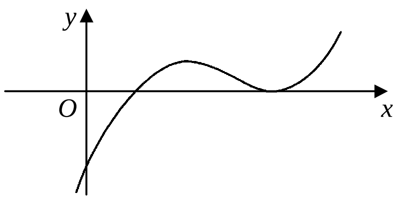
$$
\begin{array}{r|llll}
 & x^2 & -\ 8x & +\ 16 & \\
\hline
x-1 & x^3 & -\ 9x^2 & +\ 24x & -\ 16 \\
 & x^3 & -\ x^2 & & \\
\hline
 & & -\ 8x^2 & +\ 24x & \\
 & & -\ 8x^2 & +\ 8x & \\
\hline
 & & & 16x & -\ 16 \\
 & & & 16x & -\ 16 \\
\hline
\end{array}
$$

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)**