## 4722 Core Mathematics 2

		Mark	Total	
1	area of sector = $\frac{1}{2} \ge 11^2 \ge 0.7$ = 42.35 area of triangle = $\frac{1}{2} \ge 11^2 \ge 10.7$ hence area of segment = 42.35 - 38.98 = 3.37	M1 A1 M1 A1	4	Attempt sector area using $(\frac{1}{2}) r^2 \theta$ Obtain 42.35, or unsimplified equiv, soi Attempt triangle area using $\frac{1}{2}absinC$ or equiv, and subtract from attempt at sector Obtain 3.37, or better
			4	
2	area $\approx \frac{1}{2} \times 2 \times \left\{2 + 2\left(\sqrt{12} + \sqrt{28}\right) + \sqrt{52}\right\}$	M1		Attempt <i>y</i> -values at $x = 1, 3, 5, 7$ only
		M1 M1		Correct trapezium rule, any $h$ , for their $y$ values to find area between $x = 1$ and $x = 7$ Correct $h$ (soi) for their $y$ values
	≈ 26.7	A1	4	Obtain 26.7 or better (correct working only)
			4	
3	(i) $\log_a 6$	B1	1	State $\log_a 6$ cwo
	(ii) $2\log_0 x - 3\log_0 y = \log_0 x^2 - \log_0 y^3$	M1*		Use $b \log a = \log a^b$ at least once
	$= \log_{10} \frac{x^2}{y^3}$	M1de <sub>j</sub>	p*	Use $\log a - \log b = \log a/b$
		A1	3	Obtain $\log_{10} \frac{x^2}{y^3}$ cwo
			4	
4	(i) $\frac{BD}{\sin 62} = \frac{16}{\sin 50}$	M1		Attempt to use correct sine rule in $\triangle BCD$ , or equiv.
	BD = 18.4 cm	A1	2	Obtain 18.4 cm
	(ii) $18.4^2 = 10^2 + 20^2 - 2 \ge 10 \ge 20 \ge 0.3998$	M1 M1		Attempt to use correct cosine rule in $\triangle ABD$ Attempt to rearrange equation to find cos <i>BAD</i>
	$\theta = 66.4^{\circ}$	A1	3	(from $a^2 = b^2 + c^2 \pm (2)bc \cos A$ ) Obtain 66.4 <sup>0</sup>
			5	
5	$\int 12x^{\frac{1}{2}} dx = 8x^{\frac{3}{2}}$	M1		Attempt to integrate
		A1√		Obtain correct, unsimplified, integral following their $f(x)$
	3 3	A1		Obtain $8x^{\frac{2}{2}}$ , with or without + <i>c</i>
	$y = 8x^{\frac{3}{2}} + c \Longrightarrow 50 = 8 \times 4^{\frac{3}{2}} + c$	M1		Use (4, 50) to find <i>c</i>
	$\Rightarrow c = -14$	A1√		Obtain $c = -14$ , following $kx^{\frac{3}{2}}$ only
	Hence $y = 8x^{\frac{3}{2}} - 14$	A1	6	State $y = 8x^{\frac{3}{2}} - 14$ aef, as long as single power of x
			6	

**Mark Scheme** 

87(i) Some of the area is below the x-axisB11Refer to area / curve below x-axis or 'negative area'(ii)M1Attempt integration with any one term correct Obtain $\frac{1}{3}x^3 - \frac{3}{2}x^2\Big]_0^3 = (9 - \frac{27}{2}) - (0 - 0)$ M1Attempt integration with any one term correct obtain $\frac{1}{3}x^3 - \frac{3}{2}x^2$ $\left[\frac{1}{3}x^3 - \frac{3}{2}x^2\right]_0^3 = (9 - \frac{27}{2}) - (0 - 0)$ M1Use limits 3 (and 0) - correct order / subtraction Obtain (-)41/2				Mark	Total	
$u_2 = 9, u_3 = 11$ B12Correct $u_2$ and $u_3$ (ii) Arithmetic ProgressionB11Any mention of arithmetic(iii) $\frac{1}{2} \times N (14 + (N-1) \times 2) = 2200$ B1Correct interpretation of sigma notation Attempt sum of AP, and equate to 2200 Correct (unsimplified) equation Attempt to solve 3 term quadratic in N Obtain N = 44 only (N = 44 www is full mark7(i) Some of the area is below the x-axis (ii)B117(i) Some of the area is below the x-axis $= -4\frac{1}{2}$ B118(i) $u_{z} = 10x0.8^{3}$ $= 5.12$ ( $u_{z} = 10x0.8^{3}$ $= 49.4$ M18(i) $u_{z} = 10x0.8^{3}$ $= 49.4$ M18(i) $u_{z} = 10x0.8^{3}$ $= 49.4$ M11Attempt $u_{z}$ using $ar^{p-1}$ Obtain 49.4120Obtain 49.4	6	(i)	$u_1 = 7$	B1		Correct $u_1$
(ii) Arithmetic ProgressionB11Any mention of arithmetic(iii) $\frac{1}{2} N (14 + (N-1) \times 2) = 2200$ B1Correct interpretation of sigma notation Attempt dequate to 2200 $N^2 + 6N - 2200 = 0$ $(N - 44)(N + 50) = 0$ A1Correct (unsimplified) equation Attempt to solve 3 term quadratic in N $N = 44$ A157(i) Some of the area is below the x-axisB11 $I = -4\frac{1}{2}$ M1Refer to area / curve below x-axis or 'negative area'(ii) $I = -4\frac{1}{2}$ M1 $I = \frac{1}{3}x^3 - \frac{3}{2}x^2 \int_{0}^{3} = (9 - \frac{27}{2}) - (0 - 0)$ $= -4\frac{1}{2}$ M1 $I = \frac{1}{3}x^3 - \frac{3}{2}x^2 \int_{0}^{3} = (9 - \frac{27}{2}) - (0 - 0)$ $= -4\frac{1}{2}$ M1Use limits 3 (and 0) - correct order / subtraction Obtain $\frac{1}{3}x^3 - \frac{3}{2}x^2 \int_{0}^{3} = (9 - \frac{27}{2}) - (9 - \frac{27}{2})$ $= 8\frac{3}{2}$ Hence total area is $13^{1/6}$ A17Obtain total area as $13^{1/6}$ , or exact equiv SR: if no longer $f(x)dx$ , then B1 for using $[0, 3] and [3, 5]$ 8(i) $u_e = 10x0.8^3$ $= 5.12$ M1 $A1$ A12(ii) $S_{20} = \frac{10(1-0.8\frac{20}{1})}{1-0.8}$ $= 49.4$ M1 $A1$	Ū	(-)			2	
(iii) $\frac{1}{2} \times N (14 + (N-1) \times 2) = 2200$ $N^2 + 6N - 2200 = 0$ (N - 44)(N + 50) = 0 hence $N = 44$ 7 (i) Some of the area is below the x-axis (ii) $\frac{1}{2} x^3 - \frac{3}{2} x^2 \frac{1}{b}^3 = (9 - \frac{27}{2}) - (0 - 0)$ $= -4\frac{1}{2}$ $\frac{1}{2} x^3 - \frac{3}{2} x^2 \frac{1}{b}^3 = (9 - \frac{27}{2}) - (0 - 0)$ $= 8 \frac{2}{3}$ Hence total area is $13^{1}/_{6}$ 8 (i) $u_s = 10x0.8^3$ = 5.12 (ii) $S_{20} = \frac{10(1 - 0.8^{20})}{1 - 0.8}$ = 49.4 MI A1 2 N Correct interpretation of sigma notation Attempt sum of AP, and equate to 2200 Correct (unsimplified) equation Attempt sum of AP, and equate to 2200 Correct (unsimplified) equation Attempt to solve 3 term quadratic in N Obtain N = 44 only (N = 44 www is full mark B1 1 Refer to area / curve below x-axis or 'negative area' MI A1 5 B1 1 Refer to area / curve below x-axis or 'negative area' A1 7 Obtain $\frac{1}{3}x^3 - \frac{3}{2}x^2^2$ $\frac{1}{3} = \frac{(125 - 75)}{2} - (0 - 0)$ $= 8\frac{2}{3}$ A1 0btain (-4½ Use limits 5 and 3 - correct order / subtraction Obtain 8 <sup>2</sup> / <sub>3</sub> (allow 8.7 or better) A1 7 Obtain total area as 13 <sup>1</sup> / <sub>6</sub> , or exact equiv SR: if no longer $\int f(x)dx$ , then B1 for using [0, 3] and [3, 5] 8 M1 A1 2 Obtain 5.12 aef M1 A1 2 Obtain 49.4			- , ,			
$N^2 + 6N - 2200 = 0$ $(N - 44)(N + 50) = 0$ hence $N = 44$ M1 A1Attempt sum of AP, and equate to 2200 Correct (unsimplified) equation Attempt to solve 3 term quadratic in N Obtain $N = 44$ only $(N = 44)$ 7(i)Some of the area is below the x-axis $[\frac{1}{3}x^3 - \frac{3}{2}x^2]_0^3 = (9 - \frac{27}{2}) - (0 - 0)$ $= -4\frac{1}{2}$ B111Refer to area / curve below x-axis or 'negative area'M1 A1Attempt integration with any one term correct Obtain $^1/3x^3 - \frac{3}{2}x^2]_0^3 = (9 - \frac{27}{2}) - (0 - 0)$ $= -4\frac{1}{2}$ M1 A1Attempt is 3 (and 0) - correct order / subtraction Obtain $^1/3x^3 - \frac{3}{2}x^2$ $\left[\frac{1}{3}x^3 - \frac{3}{2}x^2\right]_0^3 = (9 - \frac{27}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ M1 A1Attempt use inmits 5 and 3 - correct order / subtraction Obtain $8^2/_3$ (allow 8.7 or better)A17Obtain total area as $13^1/_6$ , or exact equiv SR: if no longer $f(x)dx$ , then B1 for using $[0, 3]$ and $[3, 5]$ 8(i) $u_i = 10x0.8^3$ $= 5.12$ M1 A1Attempt u_4 using $ar^{\mu-1}$ Obtain 5.12 aef(ii) $S_{20} = \frac{10(1-0.8^{20})}{1-0.8}$ $= 49.4$ M1 A1Attempt use of correct sum formula for a GP Obtain 49.4		(ii)	Arithmetic Progression	B1	1	Any mention of arithmetic
$N^2 + 6N - 2200 = 0$ $(N - 44)(N + 50) = 0$ hence $N = 44$ M1 A1Attempt sum of AP, and equate to 2200 Correct (unsimplified) equation Attempt to solve 3 term quadratic in N Obtain $N = 44$ only $(N = 44)$ 7(i)Some of the area is below the x-axis $[\frac{1}{3}x^3 - \frac{3}{2}x^2]_0^3 = (9 - \frac{27}{2}) - (0 - 0)$ $= -4\frac{1}{2}$ B111Refer to area / curve below x-axis or 'negative area'M1 A1Attempt integration with any one term correct Obtain $^1/3x^3 - \frac{3}{2}x^2]_0^3 = (9 - \frac{27}{2}) - (0 - 0)$ $= -4\frac{1}{2}$ M1 A1Attempt is 3 (and 0) - correct order / subtraction Obtain $^1/3x^3 - \frac{3}{2}x^2$ $\left[\frac{1}{3}x^3 - \frac{3}{2}x^2\right]_0^3 = (9 - \frac{27}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ M1 A1Attempt use inmits 5 and 3 - correct order / subtraction Obtain $8^2/_3$ (allow 8.7 or better)A17Obtain total area as $13^1/_6$ , or exact equiv SR: if no longer $f(x)dx$ , then B1 for using $[0, 3]$ and $[3, 5]$ 8(i) $u_i = 10x0.8^3$ $= 5.12$ M1 A1Attempt u_4 using $ar^{\mu-1}$ Obtain 5.12 aef(ii) $S_{20} = \frac{10(1-0.8^{20})}{1-0.8}$ $= 49.4$ M1 A1Attempt use of correct sum formula for a GP Obtain 49.4		(:::)	1/N(14 + (N - 1) - 2) = 2200	D1		Competintempetation of signa notation
$\frac{N^{2} + 6N - 2200 = 0}{(N - 44)(N + 50) = 0}$ hence $N = 44$ A1 A1 B Correct (unsimplified) equation Attempt to solve 3 term quadratic in N Obtain $N = 44$ only ( $N = $		(111)	$\frac{7}{2}$ IV $(14 + (IV - 1) \times 2) - 2200$			· ·
$(N-44)(N+50) = 0$ hence $N = 44$ $M1$ A1 5 Attempt to solve 3 term quadratic in N Obtain $N = 44$ only ( $N = 44$ www is full mark $\boxed{8}$ $\boxed{8}$ (i) $\frac{1}{3}x^3 - \frac{3}{2}x^2 \frac{15}{49} = (9 - \frac{27}{27}) - (0 - 0)$ $= -4\frac{1}{2}$ ( $\frac{1}{3}x^3 - \frac{3}{2}x^2 \frac{15}{49} = (9 - \frac{27}{27}) - (0 - 0)$ $= -4\frac{1}{2}$ ( $\frac{1}{3}x^3 - \frac{3}{2}x^2 \frac{15}{49} = (9 - \frac{27}{27}) - (0 - 0)$ $= -4\frac{1}{2}$ ( $\frac{1}{3}x^3 - \frac{3}{2}x^2 \frac{15}{49} = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ H1 Use limits 5 and 3 - correct order / subtraction Obtain $8^2/_3$ (allow 8.7 or better) Hence total area is $13^{1}/_6$ ( $\frac{1}{3}x^3 = 5.12$ ( $\frac{1}{3}x^3 = \frac{10(1 - 0.8^{20})}{1 - 0.8}$ $= 49.4$ $M1$ A1			$N^2 + 6N - 2200 = 0$			
hence $N = 44$ A1 5 Obtain $N = 44$ only $(N = 44$ www is full mark <b>8</b> <b>7</b> (i) Some of the area is below the x-axis (ii) $\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_0^3 = (9 - \frac{27}{2}) - (0 - 0)$ $= -4\frac{1}{2}$ $\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_0^3 = (\frac{19-27}{2}) - (0 - 0)$ $= -4\frac{1}{2}$ $\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_0^3 = (\frac{19-27}{2}) - (0 - 0)$ $= -4\frac{1}{2}$ $\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_0^3 = (\frac{19-27}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ Hence total area is $13^{1/6}$ <b>8</b> (i) $u_4 = 10x0.8^3$ = 5.12 (ii) $S_{20} = \frac{10(1 - 0.8^{20})}{1 - 0.8}$ = 49.4 A1 <b>5</b> A1 <b>7</b> Obtain $N = 44$ only $(N = 44$ www is full mark <b>8</b> A1 <b>7</b> Obtain $N = 44$ only $(N = 44$ www is full mark <b>8</b> <b>1</b> Refer to area / curve below x-axis or 'negative area' A1 <b>1</b> A1 <b>1</b> A1 <b>1</b> A1 <b>1</b> A1 <b>1</b> <b>1</b> Refer to area / curve below x-axis or 'negative area' A1 <b>1</b> A1 <b>1</b> <b>1</b> Refer to area / curve below x-axis or 'negative area' A1 <b>1</b> A1 <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b>						
7(i)Some of the area is below the x-axisB11Refer to area / curve below x-axis or 'negative area'(ii) $\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_0^3 = (9 - \frac{27}{2}) - (0 - 0)$ M1Attempt integration with any one term correct Obtain $\frac{1}{3}x^3 - \frac{3}{2}x^2$ $\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_0^3 = (9 - \frac{27}{2}) - (0 - 0)$ M1Use limits 3 (and 0) - correct order / subtraction Obtain $(-)4\frac{1}{2}$ $\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_0^3 = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ M1Use limits 5 and 3 - correct order / subtraction Obtain $8^2/_3$ (allow 8.7 or better)Hence total area is $13^{1/6}$ A17Obtain total area as $13^{1/6}$ , or exact equiv SR: if no longer $\int f(x)dx$ , then B1 for using $[0, 3]$ and $[3, 5]$ 8(i) $u_4 = 10x0.8^3$ M1 $= 5.12$ Attempt $u_4$ using $ar^{n-1}$ Obtain 5.12 aef(ii) $S_{20} = \frac{10(1-0.8^{20})}{1-0.8}$ $= 49.4$ M1 A1Attempt use of correct sum formula for a GP A1A12Obtain 49.4				A1	5	Obtain $N = 44$ only ( $N = 44$ www is full marks)
7(i)Some of the area is below the x-axisB11Refer to area / curve below x-axis or 'negative area'(ii) $\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_0^3 = (9 - \frac{27}{2}) - (0 - 0)$ M1Attempt integration with any one term correct Obtain $\frac{1}{3}x^3 - \frac{3}{2}x^2$ $\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_0^3 = (9 - \frac{27}{2}) - (0 - 0)$ M1Use limits 3 (and 0) - correct order / subtraction Obtain $(-)4\frac{1}{2}$ $\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_0^3 = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ M1Use limits 5 and 3 - correct order / subtraction Obtain $8^2/_3$ (allow 8.7 or better)Hence total area is $13^{1/6}$ A17Obtain total area as $13^{1/6}$ , or exact equiv SR: if no longer $\int f(x)dx$ , then B1 for using $[0, 3]$ and $[3, 5]$ 8(i) $u_4 = 10x0.8^3$ M1 $= 5.12$ Attempt $u_4$ using $ar^{n-1}$ Obtain 5.12 aef(ii) $S_{20} = \frac{10(1-0.8^{20})}{1-0.8}$ $= 49.4$ M1 A1Attempt use of correct sum formula for a GP A1A12Obtain 49.4						
(ii) (ii) $\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_0^3 = (9 - \frac{27}{2}) - (0 - 0)$ $= -4\frac{1}{2}$ $\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_0^3 = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ $Hence total area is 13^{1}/6$ $8$ (i) $u_4 = 10x0.8^3$ $= 5.12$ (ii) $S_{20} = \frac{10(1 - 0.8^{20})}{1 - 0.8}$ $= 49.4$ $M1$ $A1$ $M1$ $A1$ $M1$ $A1$ $A1$ $A1$ $A1$ $A1$ $A1$ $A1$ $A$					8	
(ii) (ii) $\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_{3}^{3} = (9 - \frac{27}{2}) - (0 - 0)$ $= -4\frac{1}{2}$ (1) $\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_{3}^{3} = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ (1) Hence total area is $13^{1}/_{6}$ (2) $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{3}{2}x^2 \end{bmatrix}_{3}^{3} = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ (3) Hence total area is $13^{1}/_{6}$ (4) $\begin{bmatrix} 1 \\ 3x^3 - \frac{3}{2}x^2 \end{bmatrix}_{3}^{3} = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ (4) Hence total area is $13^{1}/_{6}$ (5) $\begin{bmatrix} 1 \\ 3x^3 - \frac{3}{2}x^2 \end{bmatrix}_{3}^{3} = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ (6) $\begin{bmatrix} 1 \\ 3x^3 - \frac{3}{2}x^2 \end{bmatrix}_{3}^{3} = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ (7) $\begin{bmatrix} 1 \\ 3x^3 - \frac{3}{2}x^2 \end{bmatrix}_{3}^{3} = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ (8) (9) (1) $\begin{bmatrix} 1 \\ 3x^3 - \frac{3}{2}x^2 \end{bmatrix}_{3}^{3} = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ (7) $\begin{bmatrix} 1 \\ 3x^3 - \frac{3}{2}x^2 \end{bmatrix}_{3}^{3} = (\frac{12}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ (8) (9) (9) (1) $\begin{bmatrix} 1 \\ 3x^3 - \frac{3}{2}x^2 \end{bmatrix}_{3}^{3} = (\frac{12}{3} - \frac{12}{3}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ (1) (1) $\begin{bmatrix} 1 \\ 3x^3 - \frac{3}{2}x^2 \end{bmatrix}_{3}^{3} = (\frac{12}{3} - \frac{12}{3}) - (9 - \frac{27}{2})$ $= 8\frac{1}{3}$ (1) (1) $\begin{bmatrix} 1 \\ 3x^3 - \frac{3}{2}x^2 \end{bmatrix}_{3}^{3} = (\frac{12}{3} - \frac{12}{3}) - (9 - \frac{27}{2})$ $= 8\frac{1}{3}$ (1) (1) $\begin{bmatrix} 1 \\ 3x^3 - \frac{3}{2}x^2 \end{bmatrix}_{3}^{3} = (\frac{12}{3} - \frac{12}{3}) - (9 - \frac{27}{3})$ $= 8\frac{1}{3}$ (1) $\begin{bmatrix} 1 \\ 3x^3 - \frac{1}{3}x^2 \end{bmatrix}_{3}^{3} = (\frac{12}{3} - \frac{12}{3}) - (9 - \frac{12}{3})$ $= 8\frac{1}{3}$ (1) $\begin{bmatrix} 1 \\ 3x^3 - \frac{1}{3}x^2 \end{bmatrix}_{3}^{3} = (\frac{12}{3} - \frac{12}{3}) - (9 - \frac{12}{3})$ $= 8\frac{1}{3}$ (1) $\begin{bmatrix} 1 \\ 3x^3 - \frac{1}{3}x^2 \end{bmatrix}_{3}^{3} = (\frac{12}{3} - \frac{12}{3}) - (9 - \frac{12}{3}) $	7	(i)	Some of the area is below the <i>x</i> -axis	B1	1	Refer to area / curve below x-axis or 'negative
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$						
$\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_0^3 = (9 - \frac{27}{2}) - (0 - 0)$ $= -4\frac{1}{2}$ $\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ $Hence total area is 13^{1/6}$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{3}{2}x^2 \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ $Hence total area is 13^{1/6}$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{3}{2}x^2 \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{3}{2}x^2 \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{3}{2}x^2 \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{3}{2}x^2 \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{3}{2}x^2 \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{3}{2}x^2 \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{3}{2}x^2 \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{3}{2}x^2 \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{3}{2}x^2 \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{3}{2}x^2 \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{13}{2}x^2 \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{75}{3}) - (9 - \frac{27}{2})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{13}{2}x^2 \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{125}{3})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{125}{3} \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{125}{3})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{125}{3} \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{125}{3})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{125}{3} \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{125}{3})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{125}{3} \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{125}{3})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{125}{3} \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{125}{3})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{125}{3} \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{125}{3})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{125}{3} \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{125}{3})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{125}{3} \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{125}{3})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{125}{3} \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{125}{3})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{125}{3} \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{125}{3})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{125}{3} \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{125}{3})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{125}{3} \end{bmatrix}_3^3 = (\frac{125}{3} - \frac{125}{3})$ $\begin{bmatrix} 1 \\ 3 \\ x^3 - \frac{125}{3} \end{bmatrix}_3^3 =$		(ii)				Attempt integration with any one term correct
$= -4\frac{1}{2}$ $\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_3^5 = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2})$ $= 8\frac{2}{3}$ $= 8\frac$						
$\begin{bmatrix} \frac{1}{3}x^3 - \frac{3}{2}x^2 \end{bmatrix}_{3}^{5} = (\frac{125}{3} - \frac{75}{2}) - (9 - \frac{27}{2}) \\ = 8\frac{2}{3} \\ \text{Hence total area is } 13^{1/6} \\ \text{Hence total area as } 13$				M1		Use limits 3 (and 0) – correct order / subtraction
$= 8\frac{2}{3}$ Hence total area is $13^{1}/_{6}$ $= 8\frac{2}{3}$ Hence total area is $13^{1}/_{6}$ $A1$ $A1$ $A1$ $A1$ $A1$ $A1$ $A1$ $A1$				A1		Obtain (-)4 <sup>1</sup> / <sub>2</sub>
Hence total area is $13^{1}/_{6}$ Hence total area is $13^{1}/_{6}$ A1 7 Obtain total area as $13^{1}/_{6}$ , or exact equiv SR: if no longer $\int f(x) dx$ , then B1 for using [0, 3] and $[3, 5]8(i) u_{4}=10x0.8^{3}= 5.12(ii) S_{20} = \frac{10(1-0.8^{20})}{1-0.8}= 49.4M1A1 2M1A1 2M1A1 2Obtain 5.12 aefM1A1 2Obtain 5.12 aefM1A1 2Obtain 49.4$			$\left[\frac{1}{3}x^3 - \frac{3}{2}x^2\right]_3^5 = \left(\frac{125}{3} - \frac{75}{2}\right) - \left(9 - \frac{27}{2}\right)$	M1		Use limits 5 and 3 – correct order / subtraction
Hence total area is $13^{1}/_{6}$ Hence total area is $13^{1}/_{6}$ A1 7 Obtain total area as $13^{1}/_{6}$ , or exact equiv SR: if no longer $\int f(x) dx$ , then B1 for using [0, 3] and $[3, 5]8(i) u_{4}=10x0.8^{3}= 5.12(ii) S_{20} = \frac{10(1-0.8^{20})}{1-0.8}= 49.4M1A1 2M1A1 2M1A1 2Obtain 5.12 aefM1A1 2Obtain 5.12 aefM1A1 2Obtain 49.4$			$=8\frac{2}{2}$	A1		Obtain $8^{2}/_{3}$ (allow 8.7 or better)
8(i) $u_4 = 10 \times 0.8^3$ $= 5.12$ M1 A1Attempt $u_4$ using $ar^{n-1}$ Obtain 5.12 aef(ii) $S_{20} = \frac{10(1-0.8^{20})}{1-0.8}$ $= 49.4$ M1 A1Attempt use of correct sum formula for a GP Obtain 49.4				A1	7	
8       (i) $u_4 = 10 \times 0.8^3$ M1       Attempt $u_4$ using $ar^{n-1}$ $= 5.12$ A1       2       Obtain 5.12 aef         (ii) $S_{20} = \frac{10(1-0.8^{20})}{1-0.8}$ M1       Attempt use of correct sum formula for a GP $= 49.4$ A1       2       Obtain 49.4			Ŭ			
8       (i) $u_4 = 10x0.8^3$ M1       Attempt $u_4$ using $ar^{n-1}$ $= 5.12$ A1       2       Obtain 5.12 aef         (ii) $S_{20} = \frac{10(1-0.8^{20})}{1-0.8}$ M1       Attempt use of correct sum formula for a GP $= 49.4$ A1       2       Obtain 49.4						
8       (i) $u_4 = 10 \times 0.8^3$ = 5.12       M1 A1       Attempt $u_4$ using $ar^{n-1}$ Obtain 5.12 aef         (ii) $S_{20} = \frac{10(1-0.8^{20})}{1-0.8}$ = 49.4       M1 A1       Attempt use of correct sum formula for a GP Obtain 49.4						[0, 3] and $[3, 5]$
8       (i) $u_4 = 10 \times 0.8^3$ = 5.12       M1 A1       Attempt $u_4$ using $ar^{n-1}$ Obtain 5.12 aef         (ii) $S_{20} = \frac{10(1-0.8^{20})}{1-0.8}$ = 49.4       M1 A1       Attempt use of correct sum formula for a GP Obtain 49.4						
(ii) $S_{20} = \frac{10(1-0.8^{20})}{1-0.8}$ = 49.4 A1 2 Obtain 5.12 aef M1 Attempt use of correct sum formula for a GP Obtain 49.4					8	
(ii) $S_{20} = \frac{10(1-0.8^{20})}{1-0.8}$ = 49.4	8	(i)	-			
= 49.4 A1 <b>2</b> Obtain 49.4			= 5.12	A1	2	Obtain 5.12 aef
= 49.4 A1 <b>2</b> Obtain 49.4			$(1 - 2 - 2^{20})$			
= 49.4 A1 <b>2</b> Obtain 49.4		(ii)	$S_{20} = \frac{10(1-0.8^{20})}{1-0.2}$	M1		Attempt use of correct sum formula for a GP
				A 1	2	Obtain 40.4
(iii) $\frac{10}{1-0.8} - \frac{10(1-0.8^N)}{(1-0.8)} < 0.01$ M1 Attempt $S_{\infty}$ using $\frac{a}{1-r}$			= 49.4	AI	2	Obtain 49.4
(iii) $\frac{1}{1-0.8} - \frac{3}{(1-0.8)} < 0.01$ (M1) Attempt $S_{\infty}$ using $\frac{u}{1-r}$		(:::)	$10  10(1-0.8^N)$	MI		Attornat S wing d
		(111)	$\frac{1}{1-0.8} - \frac{1}{(1-0.8)} < 0.01$	IVI I		Attempt $S_{\infty}$ using $\frac{u}{1-r}$
A1 Obtain $S_{\infty} = 50$ , or unsimplified equiv				A1		Obtain $S_{\infty} = 50$ , or unsimplified equiv
$50 - 50(1 - 0.8^{N}) < 0.01$ M1 Link $S_{\infty} - S_{N}$ to 0.01 and attempt to rearrange						
$0.8^N < 0.0002$ A.G. A1 Show given inequality convincingly						Show given inequality convincingly
$\log 0.8^N < \log 0.0002$ M1 Introduce logarithms on both sides			6 6			
N log 0.8 < log 0.0002 M1 Use log $a^b = b \log a$ , and attempt to find N					_	
N > 38.169, hence $N = 39$ A1 7 Obtain $N = 39$ only		N >	38.169, hence $N = 39$	Al	7	Obtain N = 39 only
					11	
				-	11	

			Mark 7	otal	
)	(i)	(90°, 2), (-90°, -2)	B1 B1	2	State at least 2 correct values State all 4 correct values (radians is B1 B0)
	(ii)	<b>(a)</b> 180 - α	B1	1	State 180 - $\alpha$
	()	<b>(b)</b> $-\alpha \text{ or } \alpha - 180$	B1	1	State - $\alpha$ or $\alpha - 180$
					(radians or unsimplified is B1B0)
	(iii)	$2\sin x = 2 - 3\cos^2 x$ $2\sin x = 2 - 3(1 - \sin^2 x)$	M1		Attempt use of $\cos^2 x = 1 - \sin^2 x$
		$2\sin(x - 2 - 3(1 - \sin x))$ $3\sin^2 x - 2\sin(x - 1) = 0$	A1		Obtain $3\sin^2 x - 2\sin x - 1 = 0$ aef with no bracket
		$(3\sin x + 1)(\sin x - 1) = 0$	M1		Attempt to solve 3 term quadratic in sinx
		$\sin x = -\frac{1}{3}, \sin x = 1$	A1		Obtain $x = -19.5^{\circ}$
		$x = -19.5^{\circ}, -161^{\circ}, 90^{\circ}$	A1√		Obtain second correct answer in range, followin
			4.1	,	their x
			A1	6	Obtain $90^{\circ}$ (radians or extra answers is max 5 out of 6)
					SR: answer only (and no extras) is B1 B1 $\sqrt{10}$ B1
			1	0	
0	(i)	$(2x+5)^4 = (2x)^4 + 4(2x)^3 5 + 6(2x)^2 5^2 + 4(2x) 5^3 + 5^4$	M1*		Attempt expansion involving powers of $2x$ and $\frac{2}{3}$
		$= 16x^4 + 160x^3 + 600x^2 + 1000x + 625$	M1*		(at least 4 terms) Attempt coefficients of 1, 4, 6, 4, 1
		104 1004 0004 10004 025	Alder	)*	Obtain two correct terms
			A1	4	Obtain a fully correct expansion
	(ii)	$(2x+5)^4 - (2x-5)^4 = 320x^3 + 2000x$	M1		Identify relevant terms (and no others) by sign
			4.1		change oe
			A1	2	Obtain $320x^3 + 2000x$ cwo
	(iii)	$9^4 - (-1)^4 = 6560$ and $7360 - 800 = 6560$ A.G.	B1		Confirm root, at any point
		$320x^3 - 1680x + 800 = 0$	M1		Attempt complete division by $(x - 2)$ or equiv
		$4x^3 - 21x + 10 = 0$	A1√		Obtain quotient of $ax^2 + 2ax + k$ , where <i>a</i> is their coeff of $x^3$
		$(x-2)(4x^2+8x-5) = 0$	A1		Obtain $(4x^2 + 8x - 5)$ (or multiple thereof)
		(x-2)(x+1)(2x+5) = 0	M1		Attempt to solve quadratic
		Hence $x = \frac{1}{2}, x = -\frac{2}{2}$	A1	6	Obtain $x = \frac{1}{2}, x = -\frac{2}{2}$
					SR: answer only is B1 B1
			Г-		
				2	