Mark Scheme 4722
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1	**(i)**	$u_2 = 12$ $u_3 = 9.6$, $u_4 = 7.68$ (or any exact equivs)	B1 B1√ **2**	State $u_2 = 12$ Correct u_3 and u_4 from their u_2
	(ii)	$S_{20} = \frac{15(1-0.8^{20})}{1-0.8}$ $= 74.1$	M1 A1 A1 **3**	Attempt use of $S_n = \frac{a(1-r^n)}{1-r}$, with n = 20 or 19 Obtain correct unsimplified expression Obtain 74.1 or better
		OR		
			M1 A2 **5**	List all 20 terms of GP Obtain 74.1
2		$\left(x+\frac{2}{x}\right)^4 = x^4 + 4x^3\left(\frac{2}{x}\right) + 6x^2\left(\frac{2}{x}\right)^2 + 4x\left(\frac{2}{x}\right)^3 + \left(\frac{2}{x}\right)^4$	M1*	Attempt expansion, using powers of x and $^2/_x$ (or the two terms in their bracket), to get at least 4 terms
			M1* A1dep* A1	Use binomial coefficients of 1, 4, 6, 4, 1 Obtain two correct, simplified, terms Obtain a further one correct, simplified, term
		$= x^4 + 8x^2 + 24 + \frac{32}{x^2} + \frac{16}{x^4}$ (or equiv)	A1 **5**	Obtain a fully correct, simplified, expansion
		OR		
			M1* M1*	Attempt expansion using all four brackets Obtain expansion containing the correct 5 powers only (could be unsimplified powers eg $x^3 . x^{-1}$)
			A1dep* A1 A1 **5**	Obtain two correct, simplified, terms Obtain a further one correct, simplified, term Obtain a fully correct, simplified, expansion
3		$\log 3^{(2x+1)} = \log 5^{200}$ $(2x+1)\log 3 = 200\log 5$	M1 M1 A1	Introduce logarithms throughout Drop power on at least one side Obtain correct linear equation (now containing no powers)
		$2x+1 = \frac{200\log 5}{\log 3}$	M1	Attempt solution of linear equation
		$x = 146$	A1 **5**	Obtain x = 146, or better
		OR		
		$(2x + 1) = \log_3 5^{200}$ $2x + 1 = 200\log_3 5$	M1 M1 A1 M1 A1 **5**	Intoduce $\log_3$ on right-hand side Drop power of 200 Obtain correct equation Attempt solution of linear equation Obtain x = 146, or better
4	**(i)**	area $\approx \frac{1}{2}\times\frac{1}{2}\times\left\{\sqrt{5}+2\left(\sqrt{7}+\sqrt{9}+\sqrt{11}\right)+\sqrt{13}\right\}$	M1 M1 A1	Attempt y-values for at least 4 of the x = 1, 1.5, 2, 2.5, 3 only Attempt to use correct trapezium rule Obtain $\frac{1}{2}\times\frac{1}{2}\times\left\{\sqrt{5}+2\left(\sqrt{7}+\sqrt{9}+\sqrt{11}\right)+\sqrt{13}\right\}$, or decimal equiv
		$\approx 0.25\times 23.766...$ ≈ 5.94	A1 **4**	Obtain 5.94 or better (answer only is 0/4)
	(ii)	This is an underestimate…… …as the tops of the trapezia are below the curve	*B1 B1dep*B1 **2** **6**	State underestimate Correct statement or sketch

5	**(i)**	$3(1-\sin^2\theta)=\sin\theta+1$ $3-3\sin^2\theta=\sin\theta+1$ $3\sin^2\theta+\sin\theta-2=0$	M1 A1	**2**	Use $\cos^2\theta=1-\sin^2\theta$ Show given equation correctly
	(ii)	$(3\sin\theta-2)(\sin\theta+1)=0$ $\sin\theta=$ ⅔ or -1 θ = 42°, 138°, 270°	M1 A1 A1 A1 A1√	**5**	Attempt to solve quadratic equation in $\sin\theta$ Both values of $\sin\theta$ correct Correct answer of 270° Correct answer of 42° For correct non-principal value answer, following their first value of θ in the required range (any extra values for θ in required range is max 4/5) (radians is max 4/5) SR: answer only (or no supporting method) is B1 for 42°, B1√ for 138°, B1 for 270°
				7	
6	**(a)**	**(i)** $\int x^3-4x=\frac{1}{4}x^4-2x^2+c$	M1 A1 B1	**3**	Expand and attempt integration Obtain ¼ x^4 – $2x^2$ (A0 if ∫ or dx still present) + c (mark can be given in (b) if not gained here)
		(ii) $\left[\frac{1}{4}x^4-2x^2\right]_1^6$ =(324 – 72) – (¼ – 2) = 253¾	M1 A1	**2**	Use limits correctly in integration attempt (ie F(6) – F(1)) Obtain 253¾ (answer only is M0A0)
	(b)	$\int 6x^{-3}\mathrm{d}x=-3x^{-2}+c$	B1 M1 A1	**3**	Use of $\frac{1}{x^3}=x^{-3}$ Obtain integral of the form kx^{-2} Obtain correct -3x^{-2} (+ c) (A0 if ∫ or dx still present, but only penalise once in question)
				8	
7	**(a)**	$S_{70}=\frac{70}{2}\{(2\times12)+(70-1)d\}$	M1 A1		Attempt S_{70} Obtain correct unsimplified expression
		35(24 + 69d) = 12915	M1		Equate attempt at S_{70} to 12915, and attempt to find d
		d = 5	A1	**4**	Obtain d = 5
	OR				
		$\frac{70}{2}\{12+l\}=12915$	M1		Attempt to find d by first equating $^n/_2(a+l)$ to 12915
		l = 357 12 + 69d = 357 d = 5	A1 M1 A1		Obtain l = 357 Equate u_{70} to l Obtain d = 5
	(b)	ar = -4 $\frac{a}{1-r}=9$ $\frac{-4}{r}=9-9r$ or $a=9-\left(9\times\frac{-4}{a}\right)$ $9r^2-9r-4=0$ $a^2-9a-36=0$ $(3r-4)(3r+1)=0$ $(a+3)(a-12)=0$ $r=\frac{4}{3}$, $r=-\frac{1}{3}$ a = -3, a = 12 Hence $r=-\frac{1}{3}$	B1 B1 M1 A1 M1 A1 A1	**7**	Correct statement for second term Correct statement for sum to infinity Attempt to eliminate either a or r Obtain correct equation (no algebraic denominators/brackets) Attempt solution of three term quadratic equation Obtain at least $r=-\frac{1}{3}$ (from correct working only) Obtain $r=-\frac{1}{3}$ only (from correct working only) SR: answer only / T&I is B2 only
				11	

8	**(i)**	$\frac{1}{2}\times AB^2\times 0.9=16.2$ $AB^2=36\Rightarrow AB=6$	M1 A1 **2**		Use $\left(\frac{1}{2}\right)r^2\theta=16.2$ Confirm AB = 6 cm (or verify ½ x 6^2 x 0.9 = 16.2)
	(ii)	$\frac{1}{2}\times 6\times AC\times\sin 0.9=32.4$ AC = 13.8 cm	M1* M1dep* A1 **3**		Use $\Delta=\frac{1}{2}bc\sin A$, or equiv Equate attempt at area to 32.4 Obtain AC = 13.8 cm, or better
	(iii)	$BC^2=6^2+13.8^2-2\times 6\times 13.8\times\cos 0.9$ Hence BC = 11.1 cm $BD=6\times 0.9=5.4$ cm Hence perimeter = 11.1 + 5.4 + (13.8 – 6) = 24.3 cm	M1 A1√ A1 B1 M1 A1 **6** **11**		Attempt use of correct cosine formula in ΔABC Correct unsimplified equation, from their AC Obtain BC = 11.1 cm, or anything that rounds to this State BD = 5.4 cm (seen anywhere in question) Attempt perimeter of region BCD Obtain 24.3 cm, or anything that rounds to this
9	**(i)**	**(a)** f (-1) = – 1 + 6 – 1 – 4 = 0	B1 **1**		Confirm f(-1) = 0, through any method
		(b) x = -1 $f(x)=(x+1)(x^2+5x-4)$ $x=\frac{-5\pm\sqrt{25+16}}{2}$ $x=\frac{1}{2}\left(-5\pm\sqrt{41}\right)$	B1 M1 A1 A1 M1 A1 **6**		State x = -1 at any point Attempt complete division by (x + 1), or equiv Obtain $x^2 + 5x + k$ Obtain completely correct quotient Attempt use of quadratic formula, or equiv, find roots Obtain $\frac{1}{2}\left(-5\pm\sqrt{41}\right)$
	(ii)	**(a)** $\log_2(x+3)^2+\log_2 x-\log_2(4x+2)=1$ $\log_2\left(\frac{(x+3)^2x}{4x+2}\right)=1$ $\frac{(x+3)^2x}{4x+2}=2$ $(x^2+6x+9)x=8x+4$ $x^3+6x^2+x-4=0$	B1 M1 A1 B1 A1 **5**		State or imply that 2log (x + 3) = log $(x+3)^2$ Add or subtract two, or more, of their algebraic logs correctly Obtain correct equation (or any equivalent, with single term on each side) Use $\log_2 a=1\Rightarrow a=2$ at any point Confirm given equation correctly
		(b) x > 0, otherwise $\log_2 x$ is undefined $x=\frac{1}{2}\left(-5+\sqrt{41}\right)$	B1* B1√dep* **2** **14**		State or imply that log x only defined for x > 0 State $x=\frac{1}{2}\left(-5+\sqrt{41}\right)$ (or x = 0.7) only, following their single positive root in (i)(b)