Mark Scheme 4722
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1 **(i)** $u_2 = 12$	B1	State $u_2 = 12$
$u_3 = 9.6$, $u_4 = 7.68$ (or any exact equivs)	B1√ **2**	Correct u_3 and u_4 from their u_2
(ii) $S_{20} = \frac{15(1-0.8^{20})}{1-0.8}$	M1	Attempt use of $S_n = \frac{a(1-r^n)}{1-r}$, with n = 20 or 19
$= 74.1$	A1	Obtain correct unsimplified expression
	A1 **3**	Obtain 74.1 or better
OR	M1	List all 20 terms of GP
	A2	Obtain 74.1
	$\boxed{5}$	
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*	Use binomial coefficients of 1, 4, 6, 4, 1
	A1dep*	Obtain two correct, simplified, terms
	A1	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*	Attempt expansion using all four brackets
	M1*	Obtain expansion containing the correct 5 powers only (could be unsimplified powers eg $x^3 . x^{-1}$)
	A1dep*	Obtain two correct, simplified, terms
	A1	Obtain a further one correct, simplified, term
	A1	Obtain a fully correct, simplified, expansion
	$\boxed{5}$	
3 $\log 3^{(2x+1)} = \log 5^{200}$	M1	Introduce logarithms throughout
$(2x+1)\log 3 = 200\log 5$	M1	Drop power on at least one side
	A1	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		
$(2x + 1) = \log_3 5^{200}$	M1	Intoduce $\log_3$ on right-hand side
$2x + 1 = 200\log_3 5$	M1	Drop power of 200
	A1	Obtain correct equation
	M1	Attempt solution of linear equation
	A1	Obtain x = 146, or better
	$\boxed{5}$	
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	Attempt y-values for at least 4 of the x = 1, 1.5, 2, 2.5, 3 only
	M1	Attempt to use correct trapezium rule
	A1	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……	*B1	State underestimate
…as the tops of the trapezia are below the curve	B1dep*B1 **2**	Correct statement or sketch
	$\boxed{6}$	

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

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