1	$(3+2x)^3 = 27+54x+36x^2+8x^3$	M1		For recognisable binomial expansion attempt
		A1		For any two terms correct, possibly unsimplified
		A1		For all four terms correct and simplified
	$(3-2x)^3 = 27-54x+36x^2-8x^3$	B1√		For changing the appropriate signs
	Hence $(3+2x)^3-(3-2x)^3 = 108x+16x^3$	A1	5	For answer $108x+16x^3$ or $4x(27+4x^2)$
			5	
2	(i) $u_2 = -1,\ u_3 = \frac{1}{2},\ u_4 = 2,\ u_5 = -1$	B1		For correct value -1 for u_2
		B1√		For correct u_3 from their u_2
		B1√	3	For correct u_4 and u_5 from their u_3 and u_4
	(ii) u_1, u_4, u_7, etc all have the value 2	B1		For recognising the repeating property
	Hence $u_{199} = 2$, giving $u_{200} = -1$	M1		For division by 3, or equivalent
		A1		For correctly linking relevant term to a term already found
		A1	4	For the correct answer -1
	(SR - Answer only is B1)			
			7	
3	(i) $\frac{LB}{\sin 65°} = \frac{200}{\sin 35°}$ OR $\frac{LA}{\sin 80°} = \frac{200}{\sin 35°}$	M1		For correct use of the sine rule in ΔLAB (could be in ii)
	$\Rightarrow LB = 316.0198\ldots$ $\Rightarrow LA = 343.39\ldots$	A1		For correct value of (or explicit expression for) LB or LA
	Hence $p = LB\sin 80° = 311$ m $p = LA\sin 65 = 311$ m	M1		For calculation of perpendicular distance
		A1	4	For correct distance (rounding to) 311
	(ii) $LC^2 = 200^2+316^2-2\times200\times316\times\cos100°$	M1		For use of cosine rule in ΔLBC or LAC
	$\left(or\ LC^2 = 400^2+343^2-2\times400\times343\times\cos65°\right)$	A1√		For correct unsimplified numerical expression for LC^2 following their LA or LB
	Hence $LC = 402$ m	A1	3	For correct distance (rounding to) 402
			7	
4	(i) $\frac{16}{1^2} = 16$ and $16 = 17-1^2$ stated			
	$1 = \frac{16}{4^2}$ and $1 = 17-4^2$ stated	B1	1	For complete verification for both points
	(ii) Area is $\int_1^4\left(17-x^2-\frac{16}{x^2}\right)dx$	M1		For appropriate subtraction (at any stage) – correct order
	$=\left[17x-\frac{1}{3}x^3+\frac{16}{x}\right]_1^4$	*M1		For integration attempt with any one term OK
		A1		For $17x-\frac{1}{3}x^3$ completely correct
		M1		For correct form kx^{-1} for third term
		A1		For correct k, for their stage of working
	$=68-\frac{64}{3}+4-17+\frac{1}{3}-16=18$	M1dep*M		For use of limits correct order
		A1	7	For correct answer 18
			8	

5	(i) $\sin\theta\tan\theta = \sin\theta\times\frac{\sin\theta}{\cos\theta} = \frac{1-\cos^2\theta}{\cos\theta}$	M1		For use of $\tan\theta = \frac{\sin\theta}{\cos\theta}$
		M1		For use of $\cos^2\theta+\sin^2\theta = 1$
	Hence $1-\cos^2\theta = \cos\theta(\cos\theta+1)$,			
	i.e. $2\cos^2\theta+\cos\theta-1=0$, or equiv	A1	3	For showing given equation correctly
	(ii) $(2\cos\theta-1)(\cos\theta+1)=0$	M1		For solution of quadratic equation in $\cos\theta$
	Hence $\cos\theta = \frac{1}{2}$ or -1	A1		For both values of $\cos\theta$ correct
	So $\theta = 60°, 300°, 180°$	A1		For correct answer 60°
		A1		For correct answer 180°
		A1√	5	For a correct non-principal-value answer, following their value of $\cos\theta$ (excluding $\cos\theta$ = -1, 0, 1) **and** no other values for θ.
			8	
6	(a) $\int(x^3+2x)\,dx = \frac{1}{4}x^4+x^2+c$	M1		For expanding and integration attempt
		A1		For $\frac{1}{4}x^4+x^2$ correct
		B1	3	For addition of an arbitrary constant (this mark can be given in **(b)(i)** if not earned here), and no dx in either
	(b) (i) $\int x^{-\frac{1}{2}}\,dx = 2x^{\frac{1}{2}}+c$	B1		For use of $\frac{1}{\sqrt{x}} = x^{-\frac{1}{2}}$
		M1		For integral of the form $kx^{\frac{1}{2}}$
		A1	3	For correct term $2x^{\frac{1}{2}}$
	(ii) $0 = 2\sqrt{4}+c \Rightarrow c = -4$	M1		For use of $x = 4$, $y = 0$ to evaluate c
		A1t		For correct c from their answer in **(b)(i)**
	Hence curve is $y = 2x^{\frac{1}{2}}-4$	A1t	3	For equation of the curve correctly stated
			9	
7	(i) Length of OD is 6 cm	B1		For stating or using the correct value of r
	Angle DOE is $\frac{1}{3}\pi$ / 1.047° / 60° / $\frac{1}{6}$ of circle	B1		For stating or using the correct angle
	Hence arc length DE is 2π cm (allow 6.28 cm)	B1		For correct use of $s = r\theta$ or equiv in degrees
	Area is $\frac{1}{2}\times6^2\times\frac{1}{3}\pi = 6\pi$ cm^2 $\left(\text{or } \frac{60}{360}\times\pi\times6^2\right)$	B1	4	For obtaining the given answer 6π correctly
	(ii) Area of small triangle is $\frac{1}{2}\times6^2\times\frac{1}{2}\sqrt{3} = 9\sqrt{3}$	*M1		For use of $\Delta = \frac{1}{2}ab\sin C$, or equivalent
		A1		For correct value $9\sqrt{3}$, or equiv
	Area of segment is $6\pi-9\sqrt{3}$	M1dep*M		For relevant use of (sector – triangle)
	Hence shaded area is $(18\sqrt{3}-6\pi)$ cm^2	A1	4	For correct answer $18\sqrt{3}-6\pi$, or exact equiv
				Scheme for alternative approaches:
		*M1		Attempt area of big triangle / rhombus / segment, using $\Delta = \frac{1}{2}ab\sin C$, or equivalent
		A1		Correct area
		M1dep*M		Relevant subtraction
		A1		For correct answer $18\sqrt{3}-6\pi$
			8	

8	(i)	(a) Sketch showing exponential growth	M1		For correct shape in at least 1st quadrant
		Intersection with y-axis is $(0, 1)$	A1	2	For 1st and 2nd quadrants, and y-coordinate 1 stated
		(b) Sketch showing exponential decay	M1		For correct shape in at least 1st quadrant
		Intersection with y-axis is $(0, 2)$	A1	2	For 1st and 2nd quadrants, and y-coordinate 2 stated
	(ii)	$a^x = 2b^x$	B1		For stating the equation in x
		Hence $x \log_2 a = \log_2 2 + x \log_2 b$	M1		For taking logs (any base)
			M1		For use of one log law
			M1		For use of a second log law
		i.e. $x = \dfrac{1}{\log_2 a - \log_2 b}$	A1	5	For showing the given answer correctly
				9	
9	(i)	$ar^3 - a = 4(ar^2 - ar)$	M1		For using ar^{n-1} to form an equation
		Hence $r^3 - 4r^2 + 4r - 1 = 0$	A1	2	For showing the given equation correctly
	(ii)	$1 - 4 + 4 - 1 = 0$	B1		For correct substitution of $r = 1$, or state no remainder
		Factors are $(r-1)(r^2 - 3r + 1)$	M1		For attempted division, or equivalent
			A1	3	For correct factor $r^2 - 3r + 1$
	(iii)	$r = \dfrac{3 \pm \sqrt{5}}{2}$	M1		For solving the relevant quadratic equation
			A1	2	For correct roots in exact form
	(iv)	The relevant value of r is $\dfrac{3-\sqrt{5}}{2}$ (or decimal equiv)	B1		For selecting the appropriate value of r
		Hence $S_\infty = \dfrac{a}{1 - \frac{1}{2}(3-\sqrt{5})}$	M1		For relevant use of $\dfrac{a}{1-r}$
		$= \dfrac{2a}{-1+\sqrt{5}} = \dfrac{2a(-1-\sqrt{5})}{(-1+\sqrt{5})(-1-\sqrt{5})}$	M1		For correct process for rationalising, using two term surd expression
		$= \frac{1}{2}a(1+\sqrt{5})$	A1	4	For showing the given answer correctly
				11	

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RECOGNISING ACHIEVEMENT

Mark Scheme 4728
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