Question	Scheme	Marks
4(a)	$\left(2+\frac{x}{8}\right)^{13}=8192+\ldots$	B1
	$+\binom{13}{1}2^{12}\left(\frac{x}{8}\right)^{1}+\binom{13}{2}2^{11}\left(\frac{x}{8}\right)^{2}+\binom{13}{3}2^{10}\left(\frac{x}{8}\right)^{3}+\ldots$	M1
	$\left(2+\frac{x}{8}\right)^{13}=(8192)+6656x+2496x^2+572x^3+\ldots$	A1A1
		(4)
(b)	$\frac{x}{8}=0.0125\Rightarrow x=0.1$	B1
	$2.0125^{13}\approx 8192+665.6+24.96+0.572$	M1
	$=8883.132$ cao	A1
		(3)
(c)	As all the terms in the expansion are positive, the truncated series will give an underestimate of the actual value.	B1
		(1)
		(8 marks)

Question Number	Scheme	Marks
2(a)	$(S=)\ 6x^2+6xh+2xh$	B1
	eg $V=3x^2h=972\Rightarrow h=\dfrac{972}{3x^2}$ or eg $hx=\dfrac{324}{x}$ $\Rightarrow(S=)\ 6x^2+8x\left(\dfrac{972}{3x^2}\right)$ or $\Rightarrow(S=)\ 6x^2+8\left(\dfrac{324}{x}\right)$	M1
	$S=6x^2+\dfrac{2592}{x}$ *	A1*
		(3)
(b)	$\left(\dfrac{dS}{dx}=\right)12x-\dfrac{2592}{x^2}$	B1
		(1)
(c)	$12x-\dfrac{2592}{x^2}=0\Rightarrow 12x^3=2592$ $\Rightarrow x=\sqrt[3]{\dfrac{2592}{12}}$	M1
	$x=6$	A1
		(2)
(d)	$\left(\dfrac{d^2S}{dx^2}=\right)12+\dfrac{5184}{x^3}$	B1ft
	$\dfrac{d^2S}{dx^2}>0$ when $x=6$ so minimum	B1
		(2)
(e)	$S=6(6)^2+\dfrac{2592}{6}=648\ (\text{cm}^2)$	B1
		(1)
		Total 9

Question	Answer	Marks	Guidance
6(a)	Obtain at least either $(\frac{1}{2}\sin\theta+\frac{1}{2}\sqrt{3}\cos\theta)$ or $(\frac{1}{2}\cos\theta+\frac{1}{2}\sqrt{3}\sin\theta)$	**B1**	Allow if implied by decimal values.
	Expand and simplify with correct use of $\sin^2\theta+\cos^2\theta=1$	**M1**	
	Use $\sin\theta\cos\theta=\frac{1}{2}\sin 2\theta$	**M1**	
	Confirm given result $\sqrt{3}+2\sin 2\theta$	**A1**	AG necessary detail required.
		4	
6(b)	Identify value of θ is $\frac{3}{8}\pi$	***B1**	OE
	Obtain $\sqrt{3}+2\sin\frac{3}{4}\pi$ and conclude $\sqrt{3}+\sqrt{2}$	**DB1**	or exact equivalent.
		2	
6(c)	Identify integrand as $\sqrt{3}+2\sin 4x$	**B1**	
	Integrate to obtain form $k_1x+k_2\cos 4x$	**M1**	where $k_1k_2\neq 0$.
	Obtain correct $\sqrt{3}x-\frac{1}{2}\cos 4x$	**A1**	
	Obtain $\frac{1}{8}\pi\sqrt{3}+\frac{1}{2}$	**A1**	or exact equivalent.
		4	

Question Number	Scheme	Marks
5 (a)	$D=8+5\sin\left(\frac{\pi\times 2}{6}+3\right)=4.07$	B1
		(1)
(b)	(b) $6=8+5\sin\left(\frac{\pi t}{6}+3\right)\Rightarrow\sin\left(\frac{\pi t}{6}+3\right)=-\frac{2}{5}$	M1 , A1
	$\Rightarrow\left(\frac{\pi t}{6}+3\right)=\arcsin\left(-\frac{2}{5}\right)=$ Any of $3.55,\ 5.87, 9.84, 12.2$	dM1
	$\Rightarrow t=$ Any of $\frac{6(3.55-3)}{\pi},\ \frac{6(5.87-3)}{\pi},\frac{6(9.84-3)}{\pi},\frac{6(12.2-3)}{\pi}$	ddM1
	13:04 or 1:04 pm	A1
		(5)
		Total 6

Question Number	Scheme	Marks
10 (a)	Uses $\tan\theta=\frac{\sin\theta}{\cos\theta}$ o.e. E.g. $\cos\theta\left(3\tan\theta+\frac{2}{\tan\theta}\right)\equiv\cos\theta\left(3\frac{\sin\theta}{\cos\theta}+\frac{2\cos\theta}{\sin\theta}\right)$	M1
	Uses $\sin^2\theta+\cos^2\theta=1$ E.g. $\equiv 3\sin\theta+\frac{2\cos^2\theta}{\sin\theta}\equiv 3\sin\theta+\frac{2\left(1-\sin^2\theta\right)}{\sin\theta}$	dM1, A1
	$\equiv 3\sin\theta+\frac{2}{\sin\theta}-2\sin\theta\equiv\sin\theta+\frac{2}{\sin\theta}$	A1*
		(4)
(b)	$\sin x+\frac{2}{\sin x}=4\sin x-5\Rightarrow 3\sin^2 x-5\sin x-2=0$	M1, A1
	$\Rightarrow\sin x=2,-\frac{1}{3}\Rightarrow x=3.5$ for example.	dM1
	$\Rightarrow x=3.48, 5.94$	A1
		(4)
		(8 marks)

Question Number	Scheme	Marks
4 (a)	$\mathrm{f}(x)=4x^3+13x^2-10x+8$ $\begin{array}{r} 4x^2+21x+32 \\ x-2\overline{)4x^3+13x^2-10x+8} \\ \underline{4x^3-8x^2} \\ 21x^2-10x \\ \underline{21x^2-42x} \\ 32x+8 \\ \underline{32x-64} \\ 72 \end{array}$ Synthetic Division $\begin{array}{c\|cccc} 2 & 4 & 13 & -10 & 8 \\ & & 8 & 42 & 64 \\ \hline & 4 & 21 & 32 & \|\ 72 \end{array}$	
(i)	$Q(x)=4x^2+21x+32$	M1, A1
(ii)	$R=72$	M1, A1 **(4)**
(b)(i)	Attempts $\mathrm{f}(-4)=4\times-64+13\times16-10\times-4+8$ $=-256+208+40+8=0$ Hence $(x+4)$ is a factor *	M1 A1*
(ii)	$\mathrm{f}(x)=4x^3+13x^2-10x+8=(x+4)\left(4x^2-3x+2\right)$	M1
	For their $4x^2-3x+2$ attempts "b^2-4ac" $=9-32$, b^2-4ac' <0 so $4x^2-3x+2$ has no real roots and $\mathrm{f}(x)=0$ has one at $x=-4$	M1 A1* **(5)**
(c)	$(\mathrm{f}'(x))=12x^2+26x-10=2(3x-1)(2x+5)$ $-\frac{5}{2}<x<\frac{1}{3}$	M1 dM1, A1 **(3)** **(12 marks)**

Question Number	Scheme	Marks
4 (a)	$\frac{a\left(1-r^3\right)}{1-r}=70.2\ ,\quad \frac{a}{1-r}=75$	B1, B1
	Sub (2) in (1) $\quad 75\left(1-r^3\right)=70.2\Rightarrow r^3=(0.064)$	M1
	$r=0.4$	A1 **(4)**
(b)	Substitutes $r=0.4$ into $\frac{a}{1-r}=75$ and finds a $a=45$	M1 A1 **(2)** **(6 marks)**