Question Number	Scheme	Marks
4 (a)	$\frac{9}{20}$	B1
		(1)
(b)	$(21k-k)\times\frac{\pi}{20}=1$	M1
	$k=\frac{1}{\pi}$ *	A1*
		(2)
(c) (i)	$\left[\mathrm{E}(X)=\frac{1}{2}(k+21k)\right]=\frac{11}{\pi}$	B1
(ii)	$\mathrm{Var}(X)=\frac{1}{12}(21k-k)^2$ or $\mathrm{Var}(X)=\int_{\frac{1}{\pi}}^{\frac{21}{\pi}}\frac{\pi}{20}x^2\,\mathrm{d}x-\left(\frac{11}{\pi}\right)^2$	M1
	$=\frac{100}{3\pi^2}$	A1
		(3)
(d)	$\mathrm{E}(A)=\pi\mathrm{E}(X^2)+4\mathrm{E}(X)+\frac{4}{\pi}$ $\mathrm{E}(A)=\int_{k}^{21k}\mathrm{f}(x)(A)\,\mathrm{d}x=\int_{k}^{21k}\frac{\pi}{20}(\pi)\left(x^2+\frac{4}{\pi}x+\frac{4}{\pi^2}\right)\mathrm{d}x$	M1
	$\mathrm{E}(X^2)=\frac{100}{3\pi^2}+\left(\frac{11}{\pi}\right)^2=\frac{463}{3\pi^2}$ $\mathrm{E}(A)=\frac{\pi}{20}(\pi)\left(\frac{x^3}{3}+(\frac{4}{\pi})\frac{x^2}{2}+\frac{4}{\pi^2}x\right)$	M1
	$\mathrm{E}(A)=\frac{463}{3\pi}+\frac{44}{\pi}+\frac{4}{\pi}$ sub limits $\frac{21}{\pi}$ and $\frac{1}{\pi}$	M1
	$=\frac{607}{3\pi}$ = awrt 64.4	A1
		(4)

	Notes	Total 10
(a)	**B1**	0.45oe cao
(b)	**M1**	use of the area of the rectangle = 1 Any equivalent rearrangement, allow $20k$ instead of $(21k - k)$
	A1*	answer is given so a fully correct solution must be seen
(c)(i)	**B1**	oe must be in terms of π (isw after correct answer seen)
(ii)	**M1**	use of $\frac{(b-a)^2}{12}$ or $\mathrm{Var}(X)=\int_{\frac{1}{\pi}}^{\frac{21}{\pi}}\frac{\pi}{20}x^2\,\mathrm{d}x-\left(\frac{11}{\pi}\right)^2$
	A1	for $\frac{100}{3\pi^2}$ oe must be in terms of π (isw after correct answer seen)
	SC	If both final answers are given in terms of k, score B1M1A0 for (c)(i) $11k$ and (c)(ii) $\frac{100}{3}k^2$
(d)	**M1**	for expanding $\mathrm{E}(A)=\mathrm{E}\left(\pi X^2+4X+\frac{4}{\pi}\right)$ **or** for setting up correct integral (ignore limits)
	M1	Valid method for finding $\mathrm{E}(X^2)$ i.e. use of $\mathrm{Var}(X)+\mathrm{E}(X)^2$ or integration of $x^2\mathrm{f}(x)$ **or** for integration of their $\mathrm{f}(x)A$ with at least one $x^n \to x^{n+1}$
	M1	substitution of their $\mathrm{E}(X)$ and their $\mathrm{E}(X^2)$ into their $\mathrm{E}(A)$ **or** for use of correct limits
	A1	for $\frac{607}{3\pi}$ or awrt 64.4