Question	Scheme	Marks
7(a)	$\left(1+2x^2\right)^{-\frac{3}{4}}=1+\left(-\frac{3}{4}\right)\left(2x^2\right)+\frac{\left(-\frac{3}{4}\right)\left(-\frac{7}{4}\right)\left(2x^2\right)^2}{2!}+\frac{\left(-\frac{3}{4}\right)\left(-\frac{7}{4}\right)\left(-\frac{11}{4}\right)\left(2x^2\right)^3}{3!}$	M1
	$=1-\frac{3}{2}x^2+\frac{21}{8}x^4-\frac{77}{16}x^6$	A1A1 [3]
(b)	$\mathrm{f}(x)=(2+kx)\left(1-\frac{3}{2}x^2+\frac{21}{8}x^4-\frac{77}{16}x^6\right)$	
	$=2+kx-3x^2-\frac{3k}{2}x^3+\frac{21}{4}x^4+\frac{21k}{8}x^5$	M1A1 [2]
(c)	$14\times(-3)=\frac{21k}{8}\Rightarrow k=\frac{14\times(-3)\times 8}{21}=-16$	M1A1 [2]
		Total 7 marks

Part	Mark	Notes
(a)	M1	For an attempt at the binomial expansion. • The expansion must begin with 1 and there must be an attempt at terms up to $\left(2x^2\right)^3$ • The denominators must be correct. • The powers of $\left(2x^2\right)$ must be correct.
	A1	For at least one term in x correct and simplified, subject to the conditions for the M mark!
	A1	For a fully correct and simplified expansion in the correct order of ascending powers.
(b)	M1	For multiplying their expansion by $(2+kx)$ provided their expansion has at least 2 terms in x with differing powers.
	A1	For a fully correct expansion.
(c)	M1	For setting $14\times\left(\text{their coeff of } x^2\right)=\left(\text{their coeff of } x^5\right)$ and attempting to solve to find a value for k
	A1	For the correct value of k

Question	Scheme	Marks

8(a)	Finds the length *DE* $x^2=(DE)^2+(DE)^2 \Rightarrow DE=\frac{x}{\sqrt{2}}$ or $DE^2=\frac{x^2}{2}$ Volume of prism $3.6=\left(\frac{x}{\sqrt{2}}\right)^2\times\frac{1}{2}\times y \Rightarrow \left[y=\frac{72}{5x^2}\right]$ Surface area of prism $S=2\times\frac{x^2}{4}+2\times\frac{x}{\sqrt{2}}\times\frac{72}{5x^2}+x\times\frac{72}{5x^2}=\left[\frac{x^2}{2}+\sqrt{2}\times\frac{72}{5x}+\frac{72}{5x}\right]$ $\Rightarrow S=\frac{x^2}{2}+\frac{72\left(\sqrt{2}+1\right)}{5x}$ *	B1 M1 M1 A1 cso [4]
(b)	$\frac{\mathrm{d}S}{\mathrm{d}x}=x-\frac{72\left(\sqrt{2}+1\right)}{5x^2}=0$ $\Rightarrow \frac{72\left(\sqrt{2}+1\right)}{5x^2}=x$ $\Rightarrow x=\sqrt[3]{\frac{72\left(\sqrt{2}+1\right)}{5}}=3.26371\ldots\approx 3.26$ (cm) $\frac{\mathrm{d}^2S}{\mathrm{d}r^2}=1+\frac{144\left(\sqrt{2}+1\right)}{5x^3}$ $\Rightarrow$ positive + positive = positive $\Rightarrow$ is always greater than 0, hence minimum	M1 M1 A1 B1ft [4]
(c)	$S_{(\min)}=\frac{3.26371^2}{2}+\frac{72\left(\sqrt{2}+1\right)}{5\times 3.26371}=15.97779\ldots\approx 16\ \left(\mathrm{cm}^2\right)$	M1A1 [2]
	Total 10 marks	

Part	Mark	Notes

(a)	B1	For using Pythagoras theorem or any appropriate trigonometry to find the length *DE* (or any equivalent side)
	M1	For using the correct formula to find the volume of a prism and rearranging to find an expression for *y* minimally of the form $y = \frac{A}{Bx^2}$ This need not be simplified.
	M1	For forming an expression for *S* using their *y* The basic expression for the surface area must be correct, with correct substitution of their values. $S = 2\times 'DE' + 2\times 'DE' \times y + xy \Rightarrow S = 2\times '\frac{x^2}{4}' + 2\times '\frac{x}{\sqrt{2}}' \times \left('\frac{72}{5x^2}'\right) + x\times\left('\frac{72}{5x^2}'\right)$
	A1 cso	For $S = \frac{x^2}{2} + \frac{72\left(\sqrt{2}+1\right)}{5x}$ as written
(b)	M1	For differentiating the **given** expression for *S* Minimally acceptable differentiated expression is as follows: $\frac{dS}{dx} = x \pm Kx^{-2}$ oe. where *K* is a constant
	M1	For setting their $\frac{dS}{dx} = 0$ and attempting to solve to obtain a value for *x*
	A1	For the correct value of *x* Accept awrt 3.26 (cm)
	B1ft	For differentiating their $\frac{dS}{dr}$ to minimally obtain $\frac{d^2S}{dr^2} = 1 \pm Lx^{-3}$ and coming to an appropriate conclusion. The justification has to be correct and complete. If they refer/use a substitution it must be seen and it must be correct.. That is, $\frac{d^2S}{dr^2} = 1 + \frac{144\left(\sqrt{2}+1\right)}{5\times 3.26^3} = 3.00...$ $3 > 0$ so positive, hence minimum Alternatively: *x* is positive so; $\text{positive} + \frac{\text{positive}}{\text{positive}} \Rightarrow \text{positive}$ hence minimum
(c)	M1	For substituting their value of *x* (provided it is positive) and attempting to find a value of *S*
	A1	For awrt $S = 16$