Question	Scheme	Marks
9(a)	$(1+2x)^{-\frac{1}{3}} = 1+\left(-\frac{1}{3}\right)(2x)+\frac{\left(-\frac{1}{3}\right)\left(-\frac{4}{3}\right)(2x)^2}{2!}+\frac{\left(-\frac{1}{3}\right)\left(-\frac{4}{3}\right)\left(-\frac{7}{3}\right)(2x)^3}{3!}+\ldots$ $=1-\frac{2x}{3}+\frac{8x^2}{9}-\frac{112x^3}{81}$	M1 A1A1 [3]
(b)	$-\frac{1}{2} < x \leqslant \frac{1}{2}$ accept $-\frac{1}{2} < x < \frac{1}{2}$	B1 [1]
(c)	$f(x) = (2+kx^2)\left(1-\frac{2x}{3}+\frac{8x^2}{9}-\frac{112x^3}{81}\right)$ $=2-\frac{4x}{3}+\frac{16}{9}x^2+kx^2-\frac{224}{81}x^3-\frac{2k}{3}x^3$	M1 M1A1 [3]
(d)	$-\frac{224}{81}-\frac{2k}{3}=-\frac{8}{3} \Rightarrow k=-\frac{4}{27}$	M1A1 [2]
(e)	$\int_{0.1}^{0.2}\left(2-\frac{4x}{3}+\frac{44x^2}{27}-\frac{8}{3}x^3\right)\mathrm{d}x=\left[2x-\frac{4x^2}{2\times3}+\frac{44x^3}{3\times27}-\frac{8x^4}{4\times3}\right]_{0.1}^{0.2}$ $=\left(2\times0.2-\frac{2\times0.2^2}{3}+\frac{44\times0.2^3}{81}-\frac{2}{3}\times0.2^4\right)-\left(2\times0.1-\frac{2\times0.1^2}{3}+\frac{44\times0.1^3}{81}-\frac{2}{3}\times0.1^4\right)$ $=0.1828$ NB: Calculator value is 0.18301744	B1FT M1A1ft M1 A1 [5]
		Total 14 marks

Part	Mark	Notes
(a)	M1	For an attempt at binomial expansion. • The first term is 1 • The denominators are correct. • The powers of x are correct.
	A1	For at least one algebraic term correct and simplified.
	A1	For a fully correct and simplified expansion.
(b)	B1	For the correct range. Accept $\|x\| < \frac{1}{2}$ Do not accept $-\frac{1}{2} \leq x \leq \frac{1}{2}$
(c)	M1	For showing the intent to multiply their expansion by $\left(2+kx^2\right)$
	M1	For expanding the two brackets up to terms in x^3. Ignore terms in higher powers.
	A1	For the correct expansion. This does not have to be simplified. Must be in ascending powers, but accept $\frac{16}{9}x^2$ and kx^2 in either order and accept $-\frac{224}{81}x^3$and $-\frac{2k}{3}x^3$ in either order. $\mathrm{f}(x) = 2 - \frac{4x}{3} + x^2\left(\frac{16}{9}+k\right) + x^3\left(-\frac{224}{81}-\frac{2k}{3}\right)$ ISW errors in collection of coefficients once correct expansion in ascending powers seen.
(d)	M1	For setting their coefficient of x^3 equal to $-\frac{8}{3}$
	A1	For the correct value of k
(e)	B1FT	For substituting in their k into coefficient for x^2 in their expansion from (c) and having the coefficient of x^3 as $-\frac{8}{3}$. If the coefficient of x^2 is not correct then the substitution must be seen to award this mark. Note: this is an M mark in epen.
	M1	For an attempt to integrate their expansion which must have 4 terms. At least two powers of x to increase by 1 (including $c \rightarrow cx$). No power of x to reduce.
	A1ft	For a correctly integrated expression follow through their 4 term polynomial. Simplified integrated expression is $2x - \frac{2x^2}{3} + \frac{44x^3}{81} - \frac{2}{3}x^4$
	M1	For substituting in 0.2 and 0.1 the correct way around in their integrated expression. Expression should not have been differentiated and needs to have changed. Not dependent on first M. Must show the substitution if their integral or their limits are incorrect. Correct awrt 0.1828 following correct integral with correct limits implies this mark.
	A1	For the correct value of awrt 0.1828 NB: The calculator value is 0.18301744