Question	Scheme	Marks
1(a)	$A=\frac{1}{9}$	B1
		(1)
(b)	$"3^{-2}"(1+\underline{(-2)(\frac{kx}{3})}+\underline{\frac{(-2)(-3)}{2}(\frac{kx}{3})^2}+...)$ or x: $3^{-2}(-2)\left(\frac{k}{3}\right)\left(=-\frac{2k}{27}\right)$ and x^2: $3^{-2}\frac{(-2)(-3)}{2}\left(\frac{k}{3}\right)^2=\frac{k^2}{27}$	B1
	$\frac{(-2)(-3)}{2}\left(\frac{k}{3}\right)^2=3\times(-2)\left(\frac{k}{3}\right)\Rightarrow ...k^2=...k$	M1
	$k^2+6k=0$ *	A1*
		(3)
(c)(i)	$k=-6$	B1
(ii)	$3^{-2}\frac{(-2)(-3)(-4)}{3!}\left(\frac{"-6"}{3}\right)^3=\frac{32}{9}$	M1A1
		(3)
		(7 marks)

Notes

Mark parts (a) and (b) as a whole.

(a)

B1: $A=\frac{1}{9}$

(b)

B1: Correct unsimplified coefficients for *x* and x^2 either in an expansion or separate for $(3+kx)^{-2}$ or for $\left(1+\frac{k}{3}\right)^{-2}$ (accept the 3^{-2} missing or incorrect). May be implied. Accept $B=-\frac{2k}{3}$ and $C=\frac{k^2}{3}$ if they forget the multiple outside. B0 if brackets on $\left(\frac{k}{3}\right)^2$ missing unless implied by recovery.

M1: Sets their coefficient of x^2 equal to 3 times their coefficient of *x* to produce a two term quadratic equation in terms of *k*.

A1*: Achieves given answer from a correct equation, but condone if *B* and *C* both missed the 3^{-2}. May be scored if *A* was incorrect.

(c)(i)

B1: $k=-6$ only. The *k* = 0 solution must be rejected.

(ii)

M1: Substitutes their non-zero value for *k* into a correct expression for the coefficient of x^3. Must include the 3^{-2}

A1: $\frac{32}{9}$ oe

Question	Scheme	Marks
2(a)	$\left(\dfrac{1}{(1+3x)(1-x)}=\dfrac{A}{1+3x}+\dfrac{B}{1-x}\Rightarrow\right) 1=A(1-x)+B(1+3x)$	B1
	when $x=1 \Rightarrow 1=4B\Rightarrow B=...$ or when $x=-\dfrac{1}{3} \Rightarrow 1=\dfrac{4}{3}A\Rightarrow A=...$	M1
	$\dfrac{3}{4(1+3x)}+\dfrac{1}{4(1-x)}$	A1
		(3)
(b)	$\int \cot y \, \mathrm{d}y=\int ... \, \mathrm{d}x \Rightarrow "\ln\sin y"=\int ... \, \mathrm{d}x$	M1
	$...=\int\left("\dfrac{3}{4(1+3x)}"+"\dfrac{1}{4(1-x)}"\right)\mathrm{d}x=...\ln(1+3x)\pm...\ln(1-x) \ \ (+c)$	M1
	$\ln\sin y=\dfrac{1}{4}\ln(1+3x)-\dfrac{1}{4}\ln(1-x) \ \ (+c)$ oe	A1ft
	$\ln\sin\left(\dfrac{\pi}{2}\right)=\dfrac{1}{4}\ln\left(1+3\times\dfrac{1}{2}\right)-\dfrac{1}{4}\ln\left(1-\dfrac{1}{2}\right)+c\Rightarrow c=...\left(=-\dfrac{1}{4}\ln 5\right)$	dM1
	$k\ln\sin y=m\ln(...)\Rightarrow \sin^k y=...^m$ or $k\ln\sin y=...\Rightarrow \sin^k y=\exp(...)$	M1
	$\sin^4 y=\dfrac{1+3x}{5(1-x)}$	A1
		(6)
		(9 marks)

Notes

(a)

B1: For a correct suitable identity without fractions, such as $1=A(1-x)+B(1+3x)$, seen or implied.

M1: Attempts to find one of the constants by either substitution or equating coefficients. May be implied by a correct value for *A* or *B* via cover up rule.

A1: $\dfrac{3}{4(1+3x)}+\dfrac{1}{4(1-x)}$ oe allow values for *A* and *B* to be stated following a correct partial fraction form, or if correct partial fractions see in (b).

(b)

M1: Attempts to separate variables to form $\cot y\dfrac{\mathrm{d}y}{\mathrm{d}x}=\mathrm{g}(x)$ (oe for cot *y*) and integrate $\cot y$. Accept any changed function for the attempt but must be attempting to integrate cot *y* (oe).

M1: Attempts to integrate their partial fractions from (a) so award for $\dfrac{...}{(1+3x)}\rightarrow ...\ln(1+3x)$ or $...\ln(4+12x)$

and $\dfrac{...}{(1-x)}\rightarrow ...\ln(1-x)$ or $...\ln(4-4x)$ oe

A1ft: Correct expression (any equivalent) (both sides). Follow through on their constants for the partial fractions. Condone the absence of the constant of integration.

dM1: Depends on second M, and must have attempted to integrate both sides. Uses the initial conditions in an equation with a constant of integration. May integrate between limits to achieve this. (Accept if a value for *c* cannot be reached from their equation.)

M1: Attempts to rearrange their equation by correctly using log work to reach the required form $\sin^n y=\mathrm{f}(x)$. Must have had *k*ln sin *y* = … (*k* may be 1). Not dependent - may be gained before finding the constant if ln *A* is used, and allow if the constant is missing.

A1: $\sin^4 y=\dfrac{1+3x}{5(1-x)}$ (oe in correct form)