Question Number	Scheme	Marks
6	$u=\sqrt{x^3+1} \Rightarrow u^2=x^3+1 \Rightarrow 2u\dfrac{\mathrm{d}u}{\mathrm{d}x}=3x^2$ or $u=\sqrt{x^3+1} \Rightarrow u^2=x^3+1 \Rightarrow 2u=3x^2\dfrac{\mathrm{d}x}{\mathrm{d}u}$ or $u=\sqrt{x^3+1} \Rightarrow \dfrac{\mathrm{d}u}{\mathrm{d}x}=\dfrac{1}{2}\left(x^3+1\right)^{-\frac{1}{2}}\times 3x^2$ or $x=(u^2-1)^{\frac{1}{3}} \Rightarrow \dfrac{\mathrm{d}x}{\mathrm{d}u}=\dfrac{2}{3}u(u^2-1)^{-\frac{2}{3}}$	B1
	e.g. $\displaystyle\int \frac{9x^5}{\sqrt{x^3+1}}\mathrm{d}x=\int \frac{9x^5}{u}\frac{2u}{3x^2}\mathrm{d}u=\int 6x^3\,\mathrm{d}u=6\int\left(u^2-1\right)\mathrm{d}u$ or e.g. $\displaystyle\int \frac{9x^5}{\sqrt{x^3+1}}\mathrm{d}x=\int \frac{9x^5}{\sqrt{x^3+1}}\frac{2\sqrt{x^3+1}}{3x^2}\mathrm{d}u=\int 6x^3\,\mathrm{d}u=6\int\left(u^2-1\right)\mathrm{d}u$	M1A1
	$6\displaystyle\int\left(u^2-1\right)\mathrm{d}u=2u^3-6u\ (+c)=2\left(x^3+1\right)^{\frac{3}{2}}-6\left(x^3+1\right)^{\frac{1}{2}}\ (+c)$	M1
	$=2\left(x^3+1\right)^{\frac{1}{2}}\left[\left(x^3+1\right)-3\right]+c=2\left(x^3+1\right)^{\frac{1}{2}}\left(x^3-2\right)+c$	A1
		(5)
		Total 5

B1: Any correct equation involving $\dfrac{\mathrm{d}u}{\mathrm{d}x}$ or $\dfrac{\mathrm{d}x}{\mathrm{d}u}$ or du and dx separately. May be implied by further work.

M1: Attempts to fully change $\displaystyle\int \frac{9x^5}{\sqrt{x^3+1}}\mathrm{d}x$ into an integral with respect to u. There must be no x's anywhere. Must include an attempt at replacing dx to get du so M0 if there is no du term present (unless implied by further work) or dx becomes du without an attempt at connecting them first. (i.e. there must have been an attempt at $\dfrac{\mathrm{d}u}{\mathrm{d}x}$ or $\dfrac{\mathrm{d}x}{\mathrm{d}u}$). Condone no integral sign for this mark.

A1: Reaches $6\displaystyle\int\left(u^2-1\right)\mathrm{d}u$ o.e. Condone the omission of the integral sign but they must have a du or implied by further work.

M1: Attempts to integrate their expression in terms of u only (usually $\int(Au^2+B)\,\mathrm{d}u$) **and** attempts to reverse the substitution so that the expression is completely in terms of x (with or without the constant of integration). For the integration look for a correct method to integrate a term i.e. $...u^n \rightarrow ...u^{n+1}$ or $B \rightarrow Bu$ or $\dfrac{C}{u} \rightarrow \ln u$ at least once. Just seeing + c is not an example of integrating.

A1: Correct expression in the required form including the + c

Question Number	Scheme	Marks
7(a)	$\frac{3x-1}{x+2}=3+\frac{...}{x+2}$ or $...-\frac{7}{x+2}$	M1
	$\frac{3x-1}{x+2}=3-\frac{7}{x+2}$	A1
		(2)
(b)	$V=(\pi)\int\left(3-\frac{7}{x+2}\right)^2\mathrm{d}x=...$	M1
	$=(\pi)\int\left(9-\frac{42}{x+2}+\frac{49}{(x+2)^2}\right)\mathrm{d}x=...-42\ln(x+2)+...$ **or** $=(\pi)\int\left(9-\frac{42}{x+2}+\frac{49}{(x+2)^2}\right)\mathrm{d}x=...+...-\frac{49}{x+2}$	M1
	$=(\pi)\int\left(9-\frac{42}{x+2}+\frac{49}{(x+2)^2}\right)\mathrm{d}x=...-42\ln(x+2)+...$ **and** $=(\pi)\int\left(9-\frac{42}{x+2}+\frac{49}{(x+2)^2}\right)\mathrm{d}x=...+...-\frac{49}{x+2}$	dM1
	$=(\pi)\int\left(9-\frac{42}{x+2}+\frac{49}{(x+2)^2}\right)\mathrm{d}x=9x-42\ln(x+2)-\frac{49}{x+2}$	A1
	$V=(\pi)\left[9x-42\ln(x+2)-\frac{49}{x+2}\right]_1^4=(\pi)\left\{36-42\ln 6-\frac{49}{6}-\left(9-42\ln 3-\frac{49}{3}\right)\right\}$	M1
	$=\pi\left(\frac{211}{6}-42\ln 2\right)$	A1
		(6)
		Total 8

(a)

M1: Obtains either $A = 3$ or $B=-7$

A1: $3-\frac{7}{x+2}$ Just stating the values of A and B is insufficient but you may award this mark if it is seen in (b). Allow $3+\frac{-7}{x+2}$ and $3+-\frac{7}{x+2}$

(b) **Condone transcription errors for the method marks** e.g. $\frac{...}{x+2}\rightarrow ...\ln(x-2)$ **provided no incorrect method is seen. Condone invisible brackets for the M marks**

M1: Uses their result from part (a) and applies the volume formula (with or without the π and condone 2π) and attempts to square the bracket. Condone if they just square the two terms in the brackets or if their squaring is poor.