Question	Scheme	Marks	AOs
14(a)	$\dfrac{du}{dx} = 3^x \ln 3$	B1	1.1b
	$\displaystyle\int_0^2 \frac{3^x}{(1+3^x)^3}\,dx = \int \frac{u}{(1+u)^3}\frac{1}{u\ln 3}\,du$	M1	1.1b
	$\displaystyle\int_0^2 \frac{3^x}{(1+3^x)^3}\,dx = \frac{1}{\ln 3}\int_1^9 \frac{1}{(1+u)^3}\,du$	A1	2.1
		(3)	
(b)	$\displaystyle\int_0^2 \frac{3^{x+2}}{(1+3^x)^3}\,dx = 9\int_0^2 \frac{3^x}{(1+3^x)^3}\,dx$ **or** $\displaystyle\frac{9}{\ln 3}\int_1^9 \frac{1}{(1+u)^3}\,du$	B1	3.1a
	$\displaystyle ...\int (1+u)^{-3}\,du \to ...(1+u)^{-2}$	M1	1.1b
	$-\dfrac{k}{2}(1+u)^{-2}$	A1	1.1b
	$\left(-\dfrac{9}{2\ln 3}(1+9)^{-2}\right)-\left(-\dfrac{9}{2\ln 3}(1+1)^{-2}\right)$	dM1	1.1b
	$\dfrac{27}{25\ln 3}$	A1	2.1
		(5)	

(8 marks)

Notes:

(a)

B1: Uses the chain rule correctly to find $\dfrac{du}{dx} = 3^x \ln 3$

M1: Attempts a complete substitution from x to u ignoring limits. dx must be replaced with du and 3^x must be replaced with u. Condone slips in finding and rearranging $\dfrac{du}{dx}$ but the 'u's must be able to cancel to achieve the given form.

A1: cso $\displaystyle\int_0^2 \frac{3^x}{(1+3^x)^3}\,dx = \frac{1}{\ln 3}\int_1^9 \frac{1}{(1+u)^3}\,du$ with no errors seen and including limits.

(b)

B1: Attempts to factor out 3^2 or 9 from the integral which may be implied e.g. by $\displaystyle\frac{9}{\ln 3}\int_1^9 \frac{1}{(1+u)^3}\,du$

M1: Writes $\ldots\int \frac{1}{(1+u)^3}\,\mathrm{d}u$ as $\ldots\int(1+u)^{-3}\,\mathrm{d}u$ and integrates, increasing the power by 1 to

$\ldots(1+u)^{-2}$

A1: Correct integration of $k\int \frac{1}{(1+u)^3}\,\mathrm{d}u$ to $-\frac{k}{2}(1+u)^{-2}$

Note that the correct expression is $-\frac{9}{2\ln 3}(1+u)^{-2}$

dM1: Substitutes in their limits from (a) into an expression of the correct form $\ldots(1+u)^{-2}$ and subtracts either way round.

A1: cso A rigorous mathematical argument leading to $\frac{27}{25\ln 3}$