Question	Scheme	Marks	AOs
10 (a)	$x > \ln\left(\frac{4}{3}\right)$	B1	2.2a
		(1)	
(b)	Attempts to apply $\int y\frac{\mathrm{d}x}{\mathrm{d}t}\mathrm{d}t$	M1	3.1a
	$\left\{\int y\frac{\mathrm{d}x}{\mathrm{d}t}\mathrm{d}t = \right\} = \int\left(\frac{1}{t+1}\right)\left(\frac{1}{t+2}\right)\mathrm{d}t$	A1	1.1b
	$\frac{1}{(t+1)(t+2)} \equiv \frac{A}{(t+1)} + \frac{B}{(t+2)} \Rightarrow 1 \equiv A(t+2) + B(t+1)$	M1	3.1a
	$\{A=1,\ B=-1 \Rightarrow\}$ gives $\frac{1}{(t+1)} - \frac{1}{(t+2)}$	A1	1.1b
	$\left\{\int\left(\frac{1}{(t+1)} - \frac{1}{(t+2)}\right)\mathrm{d}t = \right\} \ln(t+1) - \ln(t+2)$	M1	1.1b
		A1	1.1b
	$\text{Area}(R) = \left[\ln(t+1) - \ln(t+2)\right]_0^2 = (\ln 3 - \ln 4) - (\ln 1 - \ln 2)$	M1	2.2a
	$= \ln 3 - \ln 4 + \ln 2 = \ln\left(\frac{(3)(2)}{4}\right) = \ln\left(\frac{6}{4}\right)$		
	$= \ln\left(\frac{3}{2}\right)$ *	A1*	2.1
		(8)	
(b) Alt 1	Attempts to apply $\int y\,\mathrm{d}x = \int\frac{1}{\mathrm{e}^x - 2 + 1}\mathrm{d}x = \int\frac{1}{\mathrm{e}^x - 1}\mathrm{d}x$, with a substitution of $u = \mathrm{e}^x - 1$	M1	3.1a
	$\left\{\int y\,\mathrm{d}x\right\} = \int\left(\frac{1}{u}\right)\left(\frac{1}{u+1}\right)\mathrm{d}u$	A1	1.1b
	$\frac{1}{u(u+1)} \equiv \frac{A}{u} + \frac{B}{(u+1)} \Rightarrow 1 \equiv A(u+1) + Bu$	M1	3.1a
	$\{A=1,\ B=-1 \Rightarrow\}$ gives $\frac{1}{u} - \frac{1}{(u+1)}$	A1	1.1b
	$\left\{\int\left(\frac{1}{u} - \frac{1}{(u+1)}\right)\mathrm{d}u = \right\} \ln u - \ln(u+1)$	M1	1.1b
		A1	1.1b
	$\text{Area}(R) = \left[\ln u - \ln(u+1)\right]_1^3 = (\ln 3 - \ln 4) - (\ln 1 - \ln 2)$	M1	2.2a
	$= \ln 3 - \ln 4 + \ln 2 = \ln\left(\frac{(3)(2)}{4}\right) = \ln\left(\frac{6}{4}\right)$		
	$= \ln\left(\frac{3}{2}\right)$ *	A1 *	2.1
		(8)	
			(9 marks)

Question	Scheme	Marks	AOs
10 (b) Alt 2	Attempts to apply $\int y\,dx = \int \frac{1}{e^x - 2 + 1}\,dx = \int \frac{1}{e^x - 1}\,dx$, with a substitution of $v = e^x$	M1	3.1a
	$\left\{\int y\,dx\right\} = \int \left(\frac{1}{v-1}\right)\left(\frac{1}{v}\right)dv$	A1	1.1b
	$\frac{1}{(v-1)v} \equiv \frac{A}{(v-1)} + \frac{B}{v} \Rightarrow 1 \equiv Av + B(v-1)$	M1	3.1a
	$\{A = 1, B = -1 \Rightarrow\}$ gives $\frac{1}{(v-1)} - \frac{1}{v}$	A1	1.1b
	$\left\{\int \left(\frac{1}{(v-1)} - \frac{1}{v}\right)dv = \right\} \ln(v-1) - \ln v$	M1	1.1b
		A1	1.1b
	$\text{Area}(R) = [\ln(v-1) - \ln v]_2^4 = (\ln 3 - \ln 4) - (\ln 1 - \ln 2)$	M1	2.2a
	$= \ln 3 - \ln 4 + \ln 2 = \ln\left(\frac{(3)(2)}{4}\right) = \ln\left(\frac{6}{4}\right)$		
	$= \ln\left(\frac{3}{2}\right)$ *	A1 *	2.1
		(8)	

Question 10 Notes:	
(a)	
B1:	Uses $x=\ln(t+2)$ with $t>-\frac{2}{3}$ to deduce the correct domain, $x>\ln\left(\frac{4}{3}\right)$
(b)	
M1:	Attempts to solve the problem by either • a parametric process or • a Cartesian process with a substitution of either $u=\mathrm{e}^x-1$ or $v=\mathrm{e}^x$
A1:	Obtains • $\int\left(\frac{1}{t+1}\right)\left(\frac{1}{t+2}\right)\mathrm{d}t$ from a parametric approach • $\int\left(\frac{1}{u}\right)\left(\frac{1}{u+1}\right)\mathrm{d}u$ from a Cartesian approach with $u=\mathrm{e}^x-1$ • $\int\left(\frac{1}{v-1}\right)\left(\frac{1}{v}\right)\mathrm{d}v$ from a Cartesian approach with $v=\mathrm{e}^x$
M1:	Applies a strategy of attempting to express either $\frac{1}{(t+1)(t+2)}$, $\frac{1}{u(u+1)}$ or $\frac{1}{(v-1)v}$ as partial fractions
A1:	Correct partial fractions for their method
M1:	Integrates to give either • $\pm\alpha\ln(t+1)\pm\beta\ln(t+2)$ • $\pm\alpha\ln u\pm\beta\ln(u+1)$; $\alpha, \beta\neq 0$, where $u=\mathrm{e}^x-1$ • $\pm\alpha\ln(v-1)\pm\beta\ln v$; $\alpha, \beta\neq 0$, where $v=\mathrm{e}^x$
A1:	Correct integration for their method
M1:	Either • Parametric approach: Deduces and applies limits of 2 and 0 in t and subtracts the correct way round • Cartesian approach: Deduces and applies limits of 3 and 1 in u, where $u=\mathrm{e}^x-1$, and subtracts the correct way round • Cartesian approach: Deduces and applies limits of 4 and 2 in v, where $v=\mathrm{e}^x$, and subtracts the correct way round
A1*:	Correctly shows that the area of R is $\ln\left(\frac{3}{2}\right)$, with no errors seen in their working