Question Number	Scheme	Marks
2 (a)	E.g. $x=\frac{t-1}{2t+1}\Rightarrow t=\frac{x+1}{1-2x}$ or $y=\frac{6}{2t+1}\Rightarrow t=\frac{6-y}{2y}$	**M1**
	E.g. $y=\frac{6}{2t+1}\Rightarrow y=\frac{6}{2\times\left(\frac{x+1}{1-2x}\right)+1}$ or $t=\frac{6-y}{2y}\Rightarrow x=\frac{\frac{6-y}{2y}-1}{2\times\frac{6-y}{2y}+1}$	**A1**
	E.g. $y=\frac{6}{2\times\left(\frac{x+1}{1-2x}\right)+1}\Rightarrow y=\frac{6\left(1-2x\right)}{2\times\left(x+1\right)+1\left(1-2x\right)}=ax+b$	**dM1**
	E.g. $y=\frac{6\left(1-2x\right)}{3}, y=2\left(1-2x\right)$ oe so linear *	**A1***
		(4)
(b)	$y=2\left(1-2x\right)$ and $y=x+12\Rightarrow 2\left(1-2x\right)=x+12\Rightarrow x=...$	**M1**
	$x=-2$	**A1cao**
		(2)
Alt (b)	$\frac{6}{2t+1}=\frac{t-1}{2t+1}+12\Rightarrow t=\left(-\frac{1}{5}\right)$	**M1**
	$x=\frac{-\frac{1}{5}-1}{2\times-\frac{1}{5}+1}=-2$	**A1**
		(2)
		(6 marks)

Notes:

(a) Do not recover marks for part (a) from part (b) if there is an attempt at part (a). If there is no labelling mark as a whole.

M1: For an attempt to get t in terms of x or y **or** x and y $\frac{x}{y}=\frac{t-1}{6}\Rightarrow t=\frac{6x+y}{y}$ or full method to eliminate t from the equations.

A1: Forms a correct equation linking x and y only. Other forms are possible using t in terms of x and y in either equation for x or y etc.

dM1: Depends on first M. Attempts to simplify the fraction reaching a linear form in x and y. Allow if there are slips but an unsimplified equation of form $ax + by = c$ must be achieved.

A1: Achieves $y=2\left(1-2x\right)$ o.e. (and isw after a correct linear equation) and states linear or hence on line etc. There must be a reference to linearity in some form (similarly for the Alts).

(b)

M1: Solves their "$y=2\left(1-2x\right)$" (may not be linear) with $y=x+12$, E.g. $2\left(1-2x\right)=x+12\Rightarrow x=...$

A1: cao $x = -2$ (ignore any references to the *y* coordinate). Do not accept $-\frac{10}{5}$

Alt (b)
M1: Solves the parametric equations simultaneously with the line equation to find a value for *t*
A1: cao Deduces correct value for *x*.

2 (a) Alt 1	$\frac{dx}{dt} = \frac{(2t+1)-2(t-1)}{(2t+1)^2}$ and $\frac{dy}{dt} = \frac{-12}{(2t+1)^2}$ o.e.	**M1 A1**
	$\frac{dy}{dx} = \frac{dy}{dt} \div \frac{dx}{dt}$	**dM1**
	$\frac{dy}{dx} = \frac{-12}{(2t+1)^2} \div \frac{3}{(2t+1)^2} = -4$ (which is a constant,) hence linear	**A1*** **(4)**

Alt 1 (a) via differentiation **Notes:**

M1: Attempts $\frac{dx}{dt}$ and $\frac{dy}{dt}$ using appropriate rule for at least one.

A1: Both correct

dM1: Depends on first M. Attempts $\frac{dy}{dx} = \frac{dy}{dt} \div \frac{dx}{dt}$ leading to constant.

A1: Achieves $\frac{dy}{dx} = -4$ and makes suitable conclusion e.g. "hence linear" *

2 (a) Alt 2	$x = \frac{t-1}{2t+1} \Rightarrow x = A - \frac{B}{2t+1}$; $x = \frac{1}{2} - \frac{3}{2(2t+1)}$	**M1; A1**
	$x = \frac{1}{2} - \frac{3}{2\left(6/y\right)}$	**dM1**
	$x = \frac{1}{2} - \frac{1}{4}y$ hence linear *	**A1*** **(4)**

Alt 2 (a) via division **Notes:**

M1: Attempts to write *x* in terms of just 2*t*+1. E.g $x = \frac{t-1}{2t+1} \Rightarrow x = A - \frac{B}{2t+1}$.

A1: $x = \frac{1}{2} - \frac{3}{2(2t+1)}$

dM1: Uses $y = \frac{6}{2t+1}$ to form an equation linking *x* and *y*

A1: $x = \frac{1}{2} - \frac{1}{4}y$ and states linear*

2 (a) Alt 3	$ax + by = \frac{at - a + 6b}{2t+1} = \frac{k\left(2t+1\right)}{2t+1} \Rightarrow a = 2k, 6b - a = k$	**M1**
	$a = 12b - 2a \Rightarrow a = 4b$	**A1**
	E.g. $4x + y = \frac{2\left(2t+1\right)}{2t+1} = ...$	**dM1**
	$4x + y = 2$ (oe) hence linear *	**A1*** **(4)**

Alt 3 (a) via elimination **Notes:**
M1: Writes $ax+by=...$ as a single fraction and attempts to compare coefficients of numerator with the denominator. A1: Correct ratio between *a* and *b* deduced. dM1: Uses their ratio to eliminate *t* from the equation. A1: $4x+y=2$ (oe) and states linear* Note: It is possible to spot the correct values for *a* and *b* directly so the following would gain full marks: $2x+\frac{1}{2}y=\frac{2t-2+3}{2t+1}=\frac{2t+1}{2t+1}=1$ hence linear. *

Question Number	Scheme	Marks
3.	States or implies Volume = $\pi\int_{\sqrt{5}}^{5}\left(\sqrt{\frac{3x}{3x^2+5}}\right)^2 \mathrm{d}x$	**B1**
	$\int\left(\sqrt{\frac{3x}{3x^2+5}}\right)^2 \mathrm{d}x = \int\frac{3x}{(3x^2+5)}\mathrm{d}x = \frac{1}{2}\ln(3x^2+5)$	**M1A1**
	Volume = $\{\pi\}\left(\frac{1}{2}\ln(3\times25+5)-\frac{1}{2}\ln(3\times5+5)\right)$	**M1**
	$=\pi\ln 2$	**A1**
		(5 marks)

Notes:

B1: States or implies Volume = $\pi\int_{\sqrt{5}}^{5}\left(\sqrt{\frac{3x}{3x^2+5}}\right)^2 \mathrm{d}x$ o.e. The limits may be implied by subsequent work, and the dx may be missing. This is for knowing the correct formula rather than for notation. The π may be implied by later work.

M1: Attempts $\int\left(\sqrt{\frac{3x}{3x^2+5}}\right)^2 \mathrm{d}x$ to achieve $k\ln(3x^2+5)$ (oe). May use substitution, either $u = 3x^2$ or $u = 3x^2+5$, in which case they should achieve $k\ln(u+5)$ or $k\ln(u)$ (oe) respectively. Allow if the brackets are missing.

A1: Correct result of integration, which may be left unsimplified. May be in terms of u if a substitution has been used. Allow if missing brackets are recovered, but A0 if never recovered.

M1: Having achieved an integral of the form $p(x)\ln(3x^2+5)$ (allowing for missing brackets) where $p(x)$ is constant or a polynomial in x (oe in terms of u for substitution), uses the limits within their integral - substitutes **correct limits for their variable** and subtracts, allowing either way round. The π may be missing for this mark.

A1: $\pi\ln 2$ cao. Note $\frac{\pi}{2}\ln 4$ is A0 as form is not as specified.