Question	Scheme	Marks	AOs
14(a)	$\dfrac{3}{(2x-1)(x+1)}=\dfrac{A}{2x-1}+\dfrac{B}{x+1}\Rightarrow A=\ldots,\ B=\ldots$	M1	1.1b
	Either $A=2$ or $B=-1$	A1	1.1b
	$\dfrac{3}{(2x-1)(x+1)}=\dfrac{2}{2x-1}-\dfrac{1}{x+1}$	A1	1.1b
		(3)	
(b)	$\displaystyle\int \frac{1}{V}\,\mathrm{d}V=\int \frac{3}{(2t-1)(t+1)}\,\mathrm{d}t$	B1	1.1a
	$\displaystyle\int \frac{2}{2t-1}-\frac{1}{t+1}\,\mathrm{d}t=\ldots\ln(2t-1)-\ldots\ln(t+1)(+c)$	M1	3.1a
	$\ln V=\ln(2t-1)-\ln(t+1)(+c)$	A1ft	1.1b
	Substitutes $t=2, V=3\Rightarrow c=(\ln 3)$	M1	3.4
	$\ln V=\ln(2t-1)-\ln(t+1)+\ln 3$ $V=\dfrac{3(2t-1)}{(t+1)}$ *	A1*	2.1
		(5)	
	(b) Alternative separation of variables:		
	$\displaystyle\int \frac{1}{3V}\,\mathrm{d}V=\int \frac{1}{(2t-1)(t+1)}\,\mathrm{d}t$	B1	1.1a
	$\displaystyle\frac{1}{3}\int \frac{2}{2t-1}-\frac{1}{t+1}\,\mathrm{d}t=\ldots\ln(2t-1)-\ldots\ln(t+1)(+c)$	M1	3.1a
	$\frac{1}{3}\ln 3V=\frac{1}{3}\ln(2t-1)-\frac{1}{3}\ln(t+1)(+c)$	A1ft	1.1b
	Substitutes $t=2, V=3\Rightarrow c=\left(\frac{1}{3}\ln 3\right)$	M1	3.4
	$\frac{1}{3}\ln V=\frac{1}{3}\ln(2t-1)-\frac{1}{3}\ln(t+1)+\frac{1}{3}\ln 3$ $V=\dfrac{3(2t-1)}{(t+1)}$ *	A1*	2.1
		(5)	
(c)	(i) 30 (minutes)	B1	3.2a
	(ii) 6 (m^3)	B1	3.4
		(2)	
		(10 marks)	

Notes:

(a)

M1: Correct method of partial fractions leading to values for their A and B

E.g. substitution: $\dfrac{3}{(2x-1)(x+1)}=\dfrac{A}{2x-1}+\dfrac{B}{x+1}\Rightarrow 3=A(x+1)+B(2x-1)\Rightarrow A=\ldots,B=\ldots$

Or compare coefficients $\dfrac{3}{(2x-1)(x+1)}=\dfrac{A}{2x-1}+\dfrac{B}{x+1}\Rightarrow 3=x(A+2B)+A-B\Rightarrow A=\ldots,B=\ldots$

Note that $\dfrac{3}{(2x-1)(x+1)}=\dfrac{A}{2x-1}+\dfrac{B}{x+1}\Rightarrow 3=A(2x-1)+B(x+1)\Rightarrow A=\ldots,B=\ldots$ scores M0

A1: Correct value for "A" or "B"

A1: Correct partial fractions not just values for "A" and "B". $\dfrac{2}{2x-1}-\dfrac{1}{x+1}$ or e.g. $\dfrac{2}{2x-1}+\dfrac{-1}{x+1}$

Must be seen as **fractions** but if not stated here, allow if the correct fractions appear later.

(b)

B1: Separates variables $\displaystyle\int \frac{1}{V}\mathrm{d}V=\int \frac{3}{(2t-1)(t+1)}\,\mathrm{d}t$. May be implied by later work.

Condone omission of the integral signs but the dV and dt must be in the correct positions if awarding this mark in isolation but they may be implied by subsequent work.

M1: Correct attempt at integration of the partial fractions.

Look for $...\ln(2t-1)+...\ln(t+1)$ where … are constants.

Condone missing brackets around the (2t – 1) and/or the (t + 1) for this mark

A1ft: Fully correct equation following through their A and B **only**.

No requirement for +c here.

The brackets around the (2t – 1) and/or the (t + 1) must be seen or implied for this mark

M1: Attempts to find "c" or e.g. "ln k" using $t=2,\ V=3$ following an attempt at integration.

Condone poor algebra as long as $t=2,\ V=3$ is used to find a value of their constant.

Note that the constant may be found immediately after integrating or e.g. after the ln's have been combined.

A1*: Correct processing leading to the given answer $V=\dfrac{3(2t-1)}{(t+1)}$

Alternative:

B1: Separates variables $\displaystyle\int \frac{1}{3V}\mathrm{d}V=\int \frac{1}{(2t-1)(t+1)}\,\mathrm{d}t$. May be implied by later work.

Condone omission of the integral signs but the dV and dt must be in the correct positions if awarding this mark in isolation but they may be implied by subsequent work.

M1: Correct attempt at integration of the partial fractions.

Look for $...\ln(2t-1)+...\ln(t+1)$ where … are constants.

Condone missing brackets around the (2t – 1) and/or the (t + 1) for this mark

A1ft: Fully correct equation following through their A and B **only**.

No requirement for +c here.

The brackets around the (2t – 1) and/or the (t + 1) must be seen or implied for this mark

M1: Attempts to find "c" or e.g. "ln k" using $t=2,\ V=3$ following an attempt at integration.

Condone poor algebra as long as $t=2,\ V=3$ is used to find a value of their constant.

Note that the constant may be found immediately after integrating or e.g. after the ln's have been combined.

A1*: Correct processing leading to the given answer $V=\dfrac{3(2t-1)}{(t+1)}$

(Note the working may look like this:

$$\frac{1}{3}\ln 3V=\frac{1}{3}\ln(2t-1)-\frac{1}{3}\ln(t+1)+c,\ \frac{1}{3}\ln 9=\frac{1}{3}\ln(3)-\frac{1}{3}\ln 3+c,\ c=\frac{1}{3}\ln 9$$

$$\ln 3V=\ln\frac{9(2t-1)}{(t+1)}\Rightarrow 3V=\frac{9(2t-1)}{(t+1)}\Rightarrow V=\frac{3(2t-1)}{(t+1)}*)$$

Note that B0M1A1M1A1 is not possible in (b) as the B1 must be implied if all the other marks have been awarded.

Note also that some candidates may use different variables in (b) e.g.

$\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{3y}{(2x-1)(x+1)}\Rightarrow\displaystyle\int \frac{1}{y}\mathrm{d}y=\int \frac{3}{(2x-1)(x+1)}\,\mathrm{d}x$ etc. In such cases you should award marks for equivalent work but they must revert to the given variables at the end to score the final mark.

Also if e.g. a "t" becomes an "x" within their working but is recovered allow full marks.

(c)

B1: Deduces 30 minutes. Units not required so just look for 30 but allow equivalents e.g. ½ an hour.
If units are given they must be correct so do not allow e.g. 30 hours.

B1: Deduces 6 m^3. Units not required so just look for 6. Condone $V < 6$ or $V \leq 6$
If units are given they must be correct so do not allow e.g. 6 m.