Question Number	Scheme	Marks
3	$V = x^3 \Rightarrow \left(\frac{\mathrm{d}V}{\mathrm{d}x}\right) = 3x^2$	B1
	$V = 100 \Rightarrow x^3 = 100 \Rightarrow x = \sqrt[3]{100}$	B1
	$k = \frac{\mathrm{d}x}{\mathrm{d}t} = \frac{\mathrm{d}x}{\mathrm{d}V} \times \frac{\mathrm{d}V}{\mathrm{d}t} = \frac{1}{3 \times 100^{\frac{2}{3}}} \times 0.085$	M1
	$= 0.00132$	A1
		(4)
		Total 4

Notes

$\left[\text{Note: } 0.085 = \frac{17}{200}\right]$

Allow other variables in place of x but not t.

B1: $\left(\frac{\mathrm{d}V}{\mathrm{d}x}\right) = 3x^2$ seen anywhere in the working

B1: M1 in Epen Finds x when $V = 100 \Rightarrow x = \sqrt[3]{100}$ or awrt 4.64

M1: Applies $\frac{\mathrm{d}x}{\mathrm{d}t} = \frac{\mathrm{d}x}{\mathrm{d}V} \times \frac{\mathrm{d}V}{\mathrm{d}t}$ with their $\frac{\mathrm{d}V}{\mathrm{d}x} = 3x^2$ provided it is of the form $\frac{\mathrm{d}V}{\mathrm{d}x} = \mu x^2$ and their numerical value for x substituted correctly

This must lead to $\frac{\mathrm{d}x}{\mathrm{d}t} = ...$

Do not award this mark for $x = 100$ substituted here.

A1: Awrt 0.00132 (oe e.g. awrt 1.32×10^{-3}) Ignore units given.

Question Number	Scheme	Marks
4(a)	$x=\dfrac{3}{5t-2}\Rightarrow 5tx-2x=3\Rightarrow t=\dfrac{2x+3}{5x}\Rightarrow y=\dfrac{\dfrac{2x+3}{5x}}{4-\dfrac{2x+3}{5x}}$ o.e.	M1A1
	$y=\dfrac{2x+3}{18x-3}$ oe	A1
		(3)
(b)	Assume that C and l do intersect	B1
	At intersection $\dfrac{2x+3}{18x-3}=-x+1\Rightarrow 2x+3=-18x^2+21x-3\Rightarrow 18x^2-19x+6\ (=0)$ or $y=-x+1\Rightarrow \dfrac{t}{4-t}=\dfrac{3}{2-5t}+1\Rightarrow 2t-5t^2=3(4-t)+(2-5t)(4-t)$ $\Rightarrow 10t^2-27t+20\,(=0)$	M1
	$b^2-4ac=19^2-4\times 18\times 6\,(=-71)$ or $b^2-4ac=27^2-4\times 10\times 20\,(=-71)$	M1
	$b^2-4ac<0$ so there are **no real (roots)** **So *C* and *l* do not intersect**	A1
		(4)
		Total 7

Notes

(a)

M1: Finds t in terms of x **and** substitutes into y

A1: Any correct equation connecting y and x which need not be simplified for this mark.

A1: Correct equation in the required form with no errors. Accept equivalent correct expressions.

(b)

B1: Sets up a correct assumption statement. This step **must** be seen.

M1: Sets their $\dfrac{2x+3}{18x-3}=-x+1$ and multiplies up to obtain a 3 term quadratic in x

or

Uses the parametric form and sets $\dfrac{t}{4-t}=-\left(\dfrac{3}{5t-2}\right)+1$ oe and multiplies up to obtain a 3 term quadratic in t

M1: Any correct strategy for establishing the contradiction e.g. attempts the discriminant on their 3TQ. This can be part of the quadratic formula.

Complex roots are: $\dfrac{19\pm\sqrt{71}i}{36}$