Question	Scheme	Marks
4(a)	$A=\frac{1}{2}5^2\left(\theta-\sin\theta\right)\Rightarrow\frac{\mathrm{d}A}{\mathrm{d}\theta}=\frac{25}{2}\left(1\pm\cos\theta\right)$	**M1**
	$\frac{\mathrm{d}A}{\mathrm{d}\theta}=\frac{25}{2}\left(1-\cos\theta\right)$	**A1**
		(2)
(b)	$\frac{\mathrm{d}\theta}{\mathrm{d}t}=0.1$	**B1**
	$\frac{\mathrm{d}A}{\mathrm{d}t}=\frac{\mathrm{d}A}{\mathrm{d}\theta}\times\frac{\mathrm{d}\theta}{\mathrm{d}t}$ (oe)	**B1**
	$\frac{\mathrm{d}A}{\mathrm{d}t}=\frac{25}{2}\left(1-\cos\frac{\pi}{3}\right)\times0.1$	**M1**
	$=\frac{5}{8}$ (cm^2 per second)	**A1**
		(4)
		(6 marks)

(a)

M1: Attempts formula for area of segment with $r = 5$ and differentiates with respect to θ.

Look for $\alpha 5^2\left(\theta - \sin\theta\right) \Rightarrow \dfrac{\mathrm{d}A}{\mathrm{d}\theta} = \beta\left(1 \pm \cos\theta\right)$ Allow with either $\alpha = \dfrac{1}{2}$ or 1

You may see $A = \alpha 5^2\theta - \alpha 5^2 \sin\theta \Rightarrow \dfrac{\mathrm{d}A}{\mathrm{d}\theta} = \beta \pm \beta\cos\theta$ again with $\alpha = \dfrac{1}{2}$ or 1

A1: Reaches correct result with no errors seen. Allow with 12.5.

Must follow M1 (the form is given). It cannot just appear without sight of some correct working

(b)

B1: States or uses $\dfrac{\mathrm{d}\theta}{\mathrm{d}t} = 0.1$

This may be seen anywhere in the question, even in part (a) or next to the Figure

B1: States or uses a correct version of the chain rule for the given problem.

May be seen in (a) or in the question itself.

E.g $\dfrac{\mathrm{d}A}{\mathrm{d}t} = \dfrac{\mathrm{d}A}{\mathrm{d}\theta} \times \dfrac{\mathrm{d}\theta}{\mathrm{d}t}$ or $\dfrac{\mathrm{d}\theta}{\mathrm{d}A} \times \dfrac{\mathrm{d}A}{\mathrm{d}t} = \dfrac{\mathrm{d}\theta}{\mathrm{d}t}$ are two correct versions

This may be implied by an equation involving their $\dfrac{\mathrm{d}A}{\mathrm{d}\theta}$ or $\dfrac{\mathrm{d}A}{\mathrm{d}\theta} = K\left(1 - \cos\theta\right)$ and their $\dfrac{\mathrm{d}\theta}{\mathrm{d}t}$

M1: Attempts the chain rule with their (a), a correct $\dfrac{\mathrm{d}\theta}{\mathrm{d}t} = 0.1$ and $\theta = \dfrac{\pi}{3}$ to find a value for $\dfrac{\mathrm{d}A}{\mathrm{d}t}$

If they don't attempt (a), or use a made up K, condone $\dfrac{\mathrm{d}A}{\mathrm{d}t} = 0.1 \times \dfrac{1}{2}{'K'} = \dfrac{1}{20}{'K'}$, but $\dfrac{\mathrm{d}A}{\mathrm{d}\theta}$ must be of the form $K\left(1 - \cos\theta\right)$ via this route.

A1: CSO. units not required. Decimal answer is 0.625.

Cannot be scored following an incorrect part (a) but allow if they have

(a) left as $\dfrac{\mathrm{d}A}{\mathrm{d}\theta} = \dfrac{r^2}{2}\left(1 - \cos\theta\right)$ followed by (b) $\dfrac{\mathrm{d}A}{\mathrm{d}t} = \dfrac{25}{2}\left(1 - \cos\dfrac{\pi}{3}\right) \times 0.1 = \dfrac{5}{8}$ which scores 00 1111.

Question	Scheme	Marks
5(a)	$y=\dfrac{2}{t(3-t)}=1\Rightarrow 2=3t-t^2\Rightarrow t=...$	**M1**
	$\left(t^2-3t+2=\left(t-1\right)\left(t-2\right)=0\Rightarrow\right)a=1,b=2$	**A1**
		(2)
(b)	Area under curve $=\displaystyle\int_{t="1"}^{t="2"} y\,\mathrm{d}x=\int_1^2 y\frac{\mathrm{d}x}{\mathrm{d}t}\mathrm{d}t=\int_1^2\frac{2}{t(3-t)}\times(2t+2)\,\mathrm{d}t$	**M1 A1**
	$t=1\Rightarrow x=3,\quad t=2\Rightarrow x=8$	**B1**
	So area of $R=1\times\left(8-3\right)-\displaystyle\int_1^2\frac{2}{t(3-t)}\times(2t+2)\,\mathrm{d}t$	**M1**
	$=5-4\displaystyle\int_1^2\frac{t+1}{t(3-t)}\mathrm{d}t$	**A1**
		(5)
(c)(i)	$\dfrac{t+1}{t(3-t)}=\dfrac{A}{t}+\dfrac{B}{3-t}$	**M1**
	$\Rightarrow t+1=A(3-t)+Bt$ E.g. $t=0\Rightarrow 1=3A\Rightarrow A=\dfrac{1}{3}$; $t=3\Rightarrow 4=3B\Rightarrow B=\dfrac{4}{3}$	**M1**
	$\dfrac{t+1}{t(3-t)}=\dfrac{1}{3t}+\dfrac{4}{3(3-t)}$	**A1**
(ii)	$\displaystyle\int\frac{t+1}{t(3-t)}\mathrm{d}t=\int\frac{1}{3t}+\frac{4}{3(3-t)}\mathrm{d}t=\frac{1}{3}\ln t-\frac{4}{3}\ln\left(3-t\right)$	**M1**
	$\text{Area}=5-4\left[\dfrac{1}{3}\ln t-\dfrac{4}{3}\ln\left(3-t\right)\right]_1^2=5-4\left(\dfrac{1}{3}\ln 2-\dfrac{4}{3}\ln 1-\dfrac{1}{3}\ln 1+\dfrac{4}{3}\ln 2\right)$ $=5-4\left(\dfrac{1}{3}\ln 2+\dfrac{4}{3}\ln 2\right)$	**dM1**
	$=5-\dfrac{20}{3}\ln 2$	**A1**
		(6)
		(13 marks)

(a)

M1: **S**ets the y equation equal to 1 (condoning slips) and then attempts to solve the resulting quadratic equation (usual rules). May be implied by correct values if a calculator is used.

A1: Correct values. That is $a=1$ and $b=2$. Condone (t =) 1 and 2 due to the demand of the question. Correct answers with no (incorrect) working scores both marks but must be seen in part (a).

If they do state $a=3$ and $b=8$ following $t=1$ and $t=2$ score A0