Question Number	Scheme	Marks
6(a)	$\theta = 75,\ t = 0 \Rightarrow 75 = 21 + A \Rightarrow A = \ldots$	M1
	$A = 54$	A1
		(2)
(b)	$\theta = 21 + 54\mathrm{e}^{-kt} \Rightarrow 25 = 21 + 54\mathrm{e}^{-5k}$	M1
	$54\mathrm{e}^{-5k} = 4 \Rightarrow \mathrm{e}^{-5k} = \dfrac{2}{27} \Rightarrow -5k = \ln\dfrac{2}{27} \Rightarrow k = \ldots$	M1
	$k = -\dfrac{1}{5}\ln\dfrac{2}{27} = 0.521$	A1
		(3)
(c)	$\theta = 21 + 54\mathrm{e}^{-0.521t} \Rightarrow \dfrac{\mathrm{d}\theta}{\mathrm{d}t} = -28.1\ldots\mathrm{e}^{-0.521t}$	M1
	$-28.1\ldots\mathrm{e}^{-0.521T} = -9 \Rightarrow \mathrm{e}^{-0.521T} = \dfrac{9}{28.1\ldots} \Rightarrow -0.521T = \ln\left(\dfrac{9}{28.1\ldots}\right)$ $\Rightarrow T = \ln\left(\dfrac{9}{28.1\ldots}\right) \div -0.521$	dM1
	$= 2.19$	A1
		(3)

9 (a)	$(k =)\ 4\sin^2\left(\dfrac{\pi}{3}\right) - 1 = 2$ *	B1*
		(1)
(b)	(i) $x = 4\sin^2 y - 1 \Rightarrow \quad \dfrac{\mathrm{d}x}{\mathrm{d}y} = 8\sin y\cos y$ o.e.	M1 A1
	(ii) Attempts either $\sin^2 y = \dfrac{\pm x \pm 1}{4}$ or $\cos^2 y = \pm 1 \pm \dfrac{x+1}{4}$ (both for dM1)	M1 dM1
	$\dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{1}{8\sin y\cos y} = \dfrac{1}{8\times\sqrt{\dfrac{x+1}{4}}\times\sqrt{\pm 1 \pm \dfrac{x+1}{4}}} = \dfrac{1}{2\sqrt{x+1}\sqrt{3-x}}$ *	ddM1 A1*
		(6)
(c)	At $x = 2$, gradient of curve $= \dfrac{1}{2\sqrt{3}} \Rightarrow$ gradient of normal is $-2\sqrt{3}$	M1
	Point N (base length of triangle) is solution of $y - \dfrac{\pi}{3} = -2\sqrt{3}(x-2) \Rightarrow x = 2 + \dfrac{\pi}{6\sqrt{3}}$ $(= 2.3\ldots)$	dM1
	Area $= \dfrac{1}{2}\times\left(2 + \dfrac{\pi}{6\sqrt{3}}\right)\times\dfrac{\pi}{3} = \dfrac{\pi}{3} + \dfrac{\pi^2}{36\sqrt{3}}$	A1
		(3)
		(10 marks)

2	$g(x)=\dfrac{2x^2-5x+8}{x-2}$	
(a)	Sets $2x^2-5x+8=(Ax+B)(x-2)+C$ with an attempt at one constant	M1
	Attempts all 3 constants. E.g. Sets $x=2\Rightarrow C=...,-2B+C=8\Rightarrow B=...$ and compares x^2 terms gives $A=...$	dM1
	$2x-1+\dfrac{6}{x-2}$	A1
		(3)
(b)	$\int 2x-1+\dfrac{6}{x-2}\,dx=x^2-x+6\ln(x-2)$	M1 A1ft
	$\int_4^8 2x-1+\dfrac{6}{x-2}\,dx=\left[x^2-x+6\ln(x-2)\right]_4^8=56+6\ln 6-12-6\ln 2$	
	$=44+6\ln 3$	dM1 A1
		(4)
		(7 marks)

Question Number	Scheme	Marks
5(a)	$\left(\dfrac{4000e^0}{19+e^0}\right)=200$	B1
		(1)
(b)	$\dfrac{dN}{dt}=\dfrac{(19+e^{0.2t})\times 400e^{0.1t}-4000e^{0.1t}\times 0.2e^{0.2t}}{(19+e^{0.2t})^2}$	M1A1
		(2)
(c)	$(19+e^{0.2t})\times 400e^{0.1t}-4000e^{0.1t}\times 0.2e^{0.2t}=0\Rightarrow e^{0.2T}=19$	M1A1
		(2)
(d)	$e^{0.2T}=19\Rightarrow T=\dfrac{\ln 19}{0.2}\ (=14.7...)$	M1
	$N=\dfrac{4000e^{0.1"14.7"}}{19+e^{0.2"14.7"}}=458.8...\Rightarrow 459$ squirrels	dM1A1
		(3)
		(8 marks)

Question Number	Scheme	Marks
7(a)	$y=\frac{16}{9(3x-k)}=\frac{16}{27x-9k}\Rightarrow\frac{dy}{dx}=-\frac{432}{(27x-9k)^2}$	M1A0
(b)	$-\frac{432}{(27x-9k)^2}=-12\Rightarrow 12(27x-9k)^2=432$	M1
	$12(27x-9k)^2=432\Rightarrow(27x-9k)^2=36\Rightarrow 27-9k=\pm 6\Rightarrow k=...$	**d**M1
	$k=\frac{7}{3},\frac{11}{3}$	A1
(c)	$y=\frac{16}{27-21}$	M1 (B1 on ePEN)
	$y-"\frac{8}{3}"=\frac{1}{12}(x-1)$	**d**M1
	$12y-x-31=0$	A1
(d)	$\int\frac{16}{27x-9k}dx=\frac{16}{27}[\ln(27x-9k)]$	M1
	$=\frac{16}{27}[\ln(27x-21)]$	A1ft
	$\frac{16}{27}[\ln(27x-21)]_1^3=\frac{16}{27}(\ln(27(3)-21)-\ln(27-21))$	**d**M1
	$=\frac{16}{27}\ln(10)$	A1

3.	$\frac{dy}{dx}=\frac{4(x+3)^2-2(4x+1)(x+3)}{(x+3)^4}$	M1 A1
	Solves their $4(x+3)^2-2(4x+1)(x+3)=0$ $\Rightarrow(x+3)(10-4x)=0\Rightarrow x=...$	M1
	Critical value of $\frac{5}{2}$; Critical value of -3	A1; B1
	C increasing when $\frac{dy}{dx}>0\Rightarrow -3<x<\frac{5}{2}$	A1
		(6 marks)