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

(a)

B1: 200

(b)

M1: Attempts to differentiate via the quotient rule (or the product rule). Look for reaching $\frac{\left(19+\mathrm{e}^{0.2\mathrm{t}}\right)\times A\mathrm{e}^{0.1t}-B\mathrm{e}^{0.1t}\times\mathrm{e}^{0.2t}}{\left(19+\mathrm{e}^{0.2\mathrm{t}}\right)^{2}}$ or $A\mathrm{e}^{0.1t}\times\left(19+\mathrm{e}^{0.2\mathrm{t}}\right)^{-1}+B\mathrm{e}^{0.1t}\times-\left(19+\mathrm{e}^{0.2\mathrm{t}}\right)^{-2}\times\mathrm{e}^{0.2t}$ where $A, B > 0$

Condone missing brackets for the M mark.

A1: Correct unsimplified derivative and isw. Any missing brackets must have been recovered.

(c)

M1: Sets their numerator of the form $\pm P\mathrm{e}^{0.1T}\pm Q\mathrm{e}^{0.3T}$ (or unsimplified equivalent) equal to zero and rearranges to $\mathrm{e}^{0.2T}=A$

A1: $\mathrm{e}^{0.2T}=19$ and isw. Accept with t instead of T. Allow from answers to (b) with an incorrect denominator but correct numerator or negative of the numerator.

(d)

M1: Takes lns of both sides and proceeds to find a value for T (accept awrt 14.7 if method is not shown). There must be evidence of using logarithms. Alternatively score for stating or implying $\mathrm{e}^{0.1t}=\sqrt{19}$

dM1: Substitutes their positive value for T or $e^{0.1t}$ into the original equation to find a value for N. It is dependent on the previous method mark.

A1: 459 (accept 458) provided the Ms have been scored. The $e^{0.2T} = 19$ must have been genuinely found, not fluked from an incorrect numerator. However, as long as the numerator was correct in (b), this mark may be

Question Number	Scheme	Marks
6(i)	$\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right)\ \frac{4x}{2x^2+5}$	M1A1
		(2)
(ii)	$\int \frac{21x}{3x^2+k}\mathrm{d}x=\frac{7}{2}\ln(3x^2+k)\ \ (+c)$	M1A1
	$\left[\frac{7}{2}\ln(3x^2+k)\right]_1^k<7\ln 8\Rightarrow\frac{7}{2}\ln\left(\frac{3k^2+k}{3+k}\right)<7\ln 8\Rightarrow\frac{3k^2+k}{3+k}<64$	M1
	$\frac{3k^2+k}{3+k}(<)64\Rightarrow 3k^2-63k-192\ \ (<0)\Rightarrow k=\ldots$	dM1
	$k=23$	A1
		(5)
		(7 marks)

awarded if subsequent working was correct.

(i)

M1: $\frac{\ldots}{2x^2+5}$. Allow with anything for the …

A1: $\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right)\ \frac{4x}{2x^2+5}$ o.e. and isw

(ii)

M1: Attempts to integrate to an expression of the form $A\ln(3x^2+k)$ or $B\ln\left(x^2+\frac{k}{3}\right)$. Allow for cancelling x's e.g $\frac{Ax\ln(3x^2+k)}{x}$ (Allow A or B to be 1)

A1: $\frac{7}{2}\ln(3x^2+k)$ o.e. with or without the constant of integration. Condone missing brackets for this mark and condone if extra integral symbols are left in.

M1: Attempts to substitute in the limits into their changed expression (which must involve ln), sets the expression less than $7\ln 8$ (condone an equation)