

	$f(x) = 8\sin x \cos x + 4\cos^2 x - 3$	
4(a)	States or uses $\sin 2x = 2\sin x \cos x$ or $\cos 2x = \pm 2\cos^2 x \pm 1$ Uses $\sin 2x = 2\sin x \cos x$ and $\cos 2x = \pm 2\cos^2 x \pm 1$ in $f(x)$ $(f(x) =) 8\sin x \cos x + 4\cos^2 x - 3 = 4\sin 2x + 2\cos 2x - 1$	M1 dM1 A1 (3)
(b)	$R^2 = a^2 + b^2 \Rightarrow R = \sqrt{20}$ or $2\sqrt{5}$ $\tan \alpha = \frac{b}{a} \Rightarrow \alpha = \dots$ ("awrt 0.464") $(f(x) =) 2\sqrt{5} \sin(2x + 0.464) - 1$	B1ft M1 A1 (3)
(c)	(i) Maximum value = " $2\sqrt{5} - 1$ " (ii) Solves $2x + \alpha = \frac{5\pi}{2} \Rightarrow x = \dots$ $(x =) \text{awrt } 3.69$ (or $(x =) \text{awrt } 3.70$)	B1 ft M1 A1 (3)
		(9 marks)

Question Number	Scheme	Marks
2 (a) (i)	$\log_6 T = 4 - 2\log_6 x$	B1
(ii)	E.g. $\log_6 T = 4 - 2\log_6 216 \Rightarrow \log_6 T = 4 - 2 \times 3 = -2 \Rightarrow T = \dots$ $\Rightarrow T = 6^{-2} = \frac{1}{36}$	M1 A1 (3)
(b)	$\log_6 T = 4 - 2\log_6 x \Rightarrow T = 6^{4 - 2\log_6 x}$ $\Rightarrow T = 6^4 \times 6^{\log_6 x^{-2}}$ $\Rightarrow T = \frac{1296}{x^2}$	M1 dM1 A1 (3)
		(6 marks)

Question Number	Scheme	Marks
1 (a)	(2, -4)	B1, B1 (2)
(b)	(8, 6)	B1, B1 (2)
(c)	(-2, 6)	B1 (1)
		(5 marks)

Question Number	Scheme	Marks
1(a)	$gf(1) = g\left(\frac{2(1)}{3 \times 1 + 1}\right) = 4 - \left(\frac{2(1)}{3 \times 1 + 1}\right)^2$	M1
	$= \frac{15}{4}$ oe	A1
		(2)
(b)	$f(x) \dots 0$ or $f(x) < \frac{2}{3}$	B1
	$0, f(x) < \frac{2}{3}$	B1
		(2)
(c)	$y = \frac{2x}{3x+1} \Rightarrow 3xy + y = 2x \Rightarrow 3xy - 2x = -y \Rightarrow x(3y-2) = -y$ or $x = \frac{2y}{3y+1} \Rightarrow 3xy + x = 2y \Rightarrow 3xy - 2y = -x \Rightarrow y(3x-2) = -x$	M1
	$\Rightarrow f^{-1}(x) = \frac{x}{2-3x}$	A1
		(2)
(d)	$f^{-1}(x) = f(x)$ or $f^{-1}(x) = x$ or $f(x) = x$ " $\frac{x}{2-3x} = \frac{2x}{3x+1}$ " or " $\frac{x}{2-3x} = x$ " or " $\frac{2x}{3x+1} = x$ " $\Rightarrow x(3x+1) = 2x(2-3x)$ or $x = x(2-3x)$ or $2x = x(3x+1)$ $\Rightarrow x = \dots$	M1
	$x = 0, \frac{1}{3}$	A1
		(2)
		Total 8

5 (i)	States $x = 2$ $\sqrt{3} \sec x + 2 = 0 \Rightarrow \cos x = -\frac{\sqrt{3}}{2} \Rightarrow x = \dots$ $x = \frac{5\pi}{6}$	B1 M1 A1
		(3)
(ii)	Attempts to use $\cos 2\theta = 1 - 2\sin^2\theta$ $6\sin^2\theta + 10\sin\theta - 3 = 0$ $\sin\theta = \frac{-5 \pm \sqrt{43}}{6} (= -1.926\dots, 0.2595\dots) \Rightarrow \theta = \arcsin(\dots)$ $\theta = 15.0^\circ, 165^\circ$	M1 A1 M1 A1
		(4)
		(7 marks)

7 (a)

$$\begin{aligned}\sin 4\theta &\equiv 2 \sin 2\theta \cos 2\theta \\ &\equiv 2(2 \sin \theta \cos \theta)(1 - 2 \sin^2 \theta) \\ &\equiv 4 \sin \theta \cos \theta - 8 \sin^3 \theta \cos \theta \\ &\equiv \sin \theta \cos \theta (4 - 8 \sin^2 \theta)\end{aligned}$$

M1

dM1

A1

(3)

(b)

$$\begin{aligned}\sec x \sin 4x &= 5 \sin^3 x \cot x \\ \frac{1}{\cos x} \times \cos x \sin x (4 - 8 \sin^2 x) &= 5 \sin^3 x \cot x \\ \div \sin x &\Rightarrow 4 - 8 \sin^2 x = 5 \sin^2 x \cot x \\ \div \cos^2 x &\Rightarrow 4 \sec^2 x - 8 \tan^2 x = 5 \tan^2 x \cot x \\ &\Rightarrow 4 \sec^2 x - 5 \tan x - 8 \tan^2 x = 0 \quad *\end{aligned}$$

B1

M1

A1*

(3)

(c)

$$\begin{aligned}\text{Uses } \sec^2 x &= 1 + \tan^2 x \\ &\Rightarrow 4 \tan^2 x + 5 \tan x - 4 = 0 \\ &\Rightarrow \tan x = \frac{-5 \pm \sqrt{89}}{8} \Rightarrow x = \dots \\ &\Rightarrow x = \text{awrt } 0.506, 2.08\end{aligned}$$

M1

A1

dM1

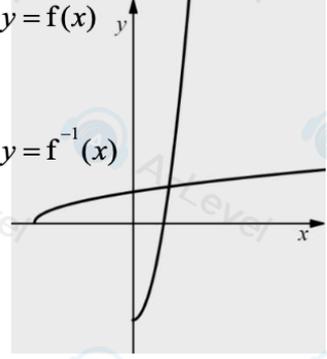
A1

(4)

(10 marks)

Question Number	Scheme	Marks
3(a)	$\log_{10} D = 1.04 + 0.38t \Rightarrow D = 10^{1.04+0.38t}$	
	or $a = 10^{1.04}$ or $b = 10^{0.38}$	M1
	$a = \text{awrt } 10.96$ or $b = \text{awrt } 2.399$	A1
	$D = 10.96 \times 2.399^t$	A1
		(3)
(b)	$45000 = "10.96" \times "2.399"^T \Rightarrow T = \dots$	
	or $\log_{10} 45000 = 1.04 + 0.38T \Rightarrow T = \dots$	M1
	awrt 9.51	A1
		(2)
(c)	$D = "10.96" \times "2.399"^{12} \Rightarrow D = \dots$	
	or $\log_{10} D = 1.04 + 0.38 \times 12 \Rightarrow D = \dots$	
	or $350000 = "10.96" \times "2.399"^t \Rightarrow t = \dots$	
	or $\log_{10} 350000 = 1.04 + 0.38 \times t \Rightarrow t = \dots$	M1
	$D = \text{awrt } (\text{£})400\,000 \Rightarrow \text{yes}$	
	or $t = \text{awrt } 11.9 \Rightarrow \text{yes}$	A1
		(2)
		(7 marks)

Question Number	Scheme	Marks
3(a)	$m = \frac{2.25 - 2}{5}$	M1
	$\log_{10} V = 0.05t + 2$	A1 (2)
(b)	$\log_{10} V = 0.05t + 2 \Rightarrow V = 10^{0.05t+2}$	M1
	$a = 100$ or $b = 1.12$ $V = 100 \times (1.12)^t$	A1 A1 (3)
(c)	$\frac{dV}{dt} = 100 \times \ln 1.12 \times (1.12)^t \quad (= 11.33(1.12)^t)$	B1ft
	$100 \times \ln 1.12 \times (1.12)^T = 50 \Rightarrow (1.12)^T = \frac{50}{100 \ln 1.12}$ $(T =) \log_{1.12} \left(\frac{50}{100 \ln 1.12} \right) = \dots$ $(T =) 13$	M1 dM1 A1 (4)
		(9 marks)

4.(a)	$f \geq -5$	B1 (1)
(b)	 <p>Curve starting on negative x-axis and passing through positive y-axis, in quadrants 1 and 2 only.</p> <p>Shape and position correct.</p>	M1 A1 (2)
(c)	$2x^2 - 5 = x$ or $2x^2 - 5 = \sqrt{\frac{x+5}{2}}$ or $x = \sqrt{\frac{x+5}{2}}$ or $2(2x^2 - 5)^2 - 5 = x$ Full attempt to solve $2x^2 - x - 5 = 0 \Rightarrow x = \dots$ exact $x = \frac{1 + \sqrt{41}}{4}$	B1 M1 A1 (3) 6 marks

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

Question Number	Scheme	Marks
8(a)	$25 = a + -(5 \times -2 + b) (\Rightarrow 25 = a + 10 - b) \Rightarrow a = 15 + b^*$	M1A1*
		(2)
(b)	$9 = a + 10 + b \Rightarrow a = \dots \text{ or } b = \dots$ $a = 7, b = -8$	M1 A1A1
		(3)
(c)	$\left(\frac{8}{5}, 7\right)$	B1ftB1
		(2)
(d)	$15 - 5x = -2x^3 + 5x^2 + 4x - 3 \Rightarrow 2x^3 - 5x^2 - 9x + 18 = 0$ $2x^3 - 5x^2 - 9x + 18 = (x+2)(2x^2 - 9x + 9)$ $2x^2 - 9x + 9 = 0 \Rightarrow x = \frac{3}{2} \text{ (ignore } x = 3)$ $\left(\frac{3}{2}, \frac{15}{2}\right)$	M1 dM1A1 ddM1 M1A1
		(6)
		(13 marks)