

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

Question Number	Scheme	Marks
2(a)	$ff(6) = f\left(\frac{9}{2}\right) = \frac{\frac{9}{2} + 3}{\frac{9}{2} - 4} = \dots; = 15$	M1; A1
		(2)
(b)	$f^{-1}(x) = \frac{4x+3}{x-1}$	M1A1
	$x \in \mathbb{R}, x \neq 1$	B1
		(3)
(c)	E.g. $\left(\frac{x+3}{x-4}\right)^2 + 5 = 7$ or $\frac{a+3}{a-4} = (\pm)\sqrt{7-5}$	M1
	$\Rightarrow x^2 - 22x + 23 = 0 \Rightarrow x = \dots$ or $(a+3) = (\pm)\sqrt{2}(a-4) \Rightarrow a = \dots$	dM1
	$(a =) 11 + 7\sqrt{2}$ oe	A1
		(3)

9(a)	$k = -1$	B1 (1)
(b)(i)	$f(0) = 2 - 4 \ln(0+1) = 2 - 0 = 2$	B1
(ii)	$0 = 2 - 4 \ln(x+1) \Rightarrow \ln(x+1) = \frac{1}{2} \Rightarrow x = e^{\frac{1}{2}} - 1$	M1
	$x = e^{\frac{1}{2}} - 1$	A1 (3)
(c)	$2 - 4 \ln(x+1) = 3 \Rightarrow \ln(x+1) = \dots$ or $-2 + 4 \ln(x+1) = 3 \Rightarrow \ln(x+1) = \dots$	M1
	$2 - 4 \ln(x+1) = 3 \Rightarrow x = \dots$ and $-2 + 4 \ln(x+1) = 3 \Rightarrow x = \dots$	ddM1
	CVs $e^{-\frac{1}{4}} - 1, e^{\frac{5}{4}} - 1$	A1
	$-1 < x < e^{\frac{1}{4}} - 1$ or $x > e^{\frac{5}{4}} - 1$	ddM1A1ft
		(5)
		(9 marks)

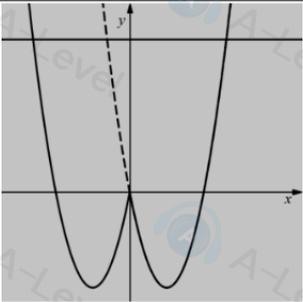
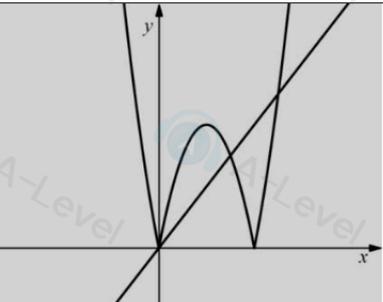
Question Number	Scheme	Marks
6(a)	$\theta = 75, t = 0 \Rightarrow 75 = 21 + A \Rightarrow A = \dots$	M1
	$A = 54$	A1
		(2)
(b)	$\theta = 21 + 54e^{-kt} \Rightarrow 25 = 21 + 54e^{-5k}$	M1
	$54e^{-5k} = 4 \Rightarrow e^{-5k} = \frac{2}{27} \Rightarrow -5k = \ln \frac{2}{27} \Rightarrow k = \dots$	M1
	$k = -\frac{1}{5} \ln \frac{2}{27} = 0.521$	A1
		(3)

(c)	$\theta = 21 + 54e^{-0.521t} \Rightarrow \frac{d\theta}{dt} = -28.1\dots e^{-0.521t}$	M1
	$-28.1\dots e^{-0.521T} = -9 \Rightarrow e^{-0.521T} = \frac{9}{28.1\dots} \Rightarrow -0.521T = \ln\left(\frac{9}{28.1\dots}\right)$	dM1
	$\Rightarrow T = \ln\left(\frac{9}{28.1\dots}\right) \div -0.521$	
	$= 2.19$	A1
		(3)

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

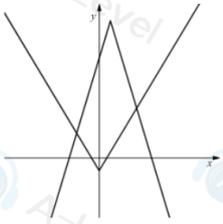
2(a)	$R = 25$	B1
	$\tan \alpha = \frac{24}{7} \Rightarrow \alpha = \dots$	M1
	$\alpha = 1.287$	A1
		(3)
(b)(i)	$\text{Min} = \frac{5}{90 - 3 \times 25 \times (-1)}$	M1
	$= \frac{1}{33}$	A1
(b)(ii)	$(2x + 1.287) = \pi, \dots \Rightarrow x = \dots$	M1
	$\Rightarrow x = \frac{\pi - 1.287}{2} = 0.927$	A1
		(4)
		Total 7

Question Number	Scheme	Marks
1(a)	$f(x) \geq \ln 3$	B1
		(1)
(b)	$g^{-1}(x) = \frac{3-2x}{x-5}$ or $-2 - \frac{7}{x-5}$ oe	M1A1
	$x < 5$	B1
		(3)
(c)	$g(0) = \frac{3}{2} \Rightarrow f\left(\frac{3}{2}\right) = \ln\left(\frac{21}{4}\right)$	M1A1
		(2)
(d)	$\frac{3+5e^{2a}}{e^{2a}+2} = 4 \Rightarrow 5e^{2a} + 3 = 4e^{2a} + 8 \Rightarrow e^{2a} = \dots$	M1
	$e^{2a} = 5 \Rightarrow 2a = \ln 5 \Rightarrow a = \dots$	dM1
	$a = \frac{1}{2} \ln 5$	A1
		(3)
		(9 marks)

3 (a)	 <p>Graphical interpretation of</p> $f(x) = 48$	
One of 8, -8		B1
Attempts to solve an appropriate equation E.g. $2x^2 - 10x = 48 \Rightarrow x^2 - 5x - 24 = 0 \Rightarrow (x \pm 8)(x \pm 3) = 0 \Rightarrow x = \dots$		M1
x = 8, -8 with no additional values		A1
(3)		
(b)	 <p>Graphical interpretation of</p> $ f(x) \dots \frac{5}{2}x$	
Attempts to solve $2x^2 - 10x = \frac{5}{2}x \Rightarrow 4x^2 - 25x = 0 \Rightarrow x = \frac{25}{4}$		M1
OR attempts to solve (o.e.) $10x - 2x^2 = \frac{5}{2}x \Rightarrow 4x^2 - 15x = 0 \Rightarrow x = \frac{15}{4}$		
Attempts to solve $2x^2 - 10x = \frac{5}{2}x \Rightarrow 4x^2 - 25x = 0 \Rightarrow x = \frac{25}{4}$		dM1
AND attempts to solve (o.e.) $10x - 2x^2 = \frac{5}{2}x \Rightarrow 4x^2 - 15x = 0 \Rightarrow x = \frac{15}{4}$		
Achieves both critical values $x = \frac{15}{4}, x = \frac{25}{4}$		A1
Correct set of values $x, \frac{15}{4}$ or $x \dots \frac{25}{4}$		A1
(4)		
8(a)	Starting with the LHS: $2\operatorname{cosec}^2 2\theta(1 - \cos 2\theta) = \frac{2 - 2\cos 2\theta}{\sin^2 2\theta}$	M1
$= \frac{2 - 2(1 - 2\sin^2 \theta)}{4\sin^2 \theta \cos^2 \theta}$		M1dM1
$= \sec^2 \theta = 1 + \tan^2 \theta \equiv \text{RHS} \quad *$		A1*
(4)		
(b)	$\sec^2 x - 3\sec x - 4 = 0 \Rightarrow \sec x = \dots$	M1
$\cos x = \frac{1}{4} \quad (\text{ignore } -1)$		A1
$\cos x = \frac{1}{4} \Rightarrow x = \dots$		dM1
$x = 75.5^\circ, 284.5^\circ$		A1
(4)		
(8 marks)		

1	$3 \tan^2 \theta + 7 \sec \theta - 3 = 0 \Rightarrow 3(\sec^2 \theta - 1) + 7 \sec \theta - 3 = 0$	M1
	$3 \sec^2 \theta + 7 \sec \theta - 6 = 0$	A1
	$(3 \sec \theta - 2)(\sec \theta + 3) = 0 \Rightarrow \sec \theta = \dots \Rightarrow \cos \theta = \dots$	dM1
	$\theta = 109.5^\circ, 250.5^\circ$	A1, A1
		(5)

Question Number	Scheme	Marks
8(a)(i)	$\left(\frac{b}{2}, a\right)$	B1B1
(ii)	$(0, a-b)$	B1
(iii)	$\left(\frac{b-a}{2}, 0\right)$ and $\left(\frac{a+b}{2}, 0\right)$	B1B1
		(5)

(b)		B1B1
		(2)
(c)	$-x-1=2x+a-b, x=-3 \Rightarrow 2=-6+a-b$ or $x-1=a+b-2x, x=5 \Rightarrow 5-1=a+b-10$	M1
	$-x-1=2x+a-b, x=-3 \Rightarrow 2=-6+a-b$ and $x-1=a+b-2x, x=5 \Rightarrow 5-1=a+b-10$	dM1 (A1 on ePEN)
	$a-b=8$ $a+b=14 \Rightarrow a=\dots$ or $b=\dots$	ddM1
	$a=11, b=3$	A1
		(4)
		(11 marks)