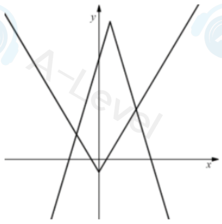
Question Number	Scheme	Marks
8(a)	$25=a+-(5\times-2+b)\ (\Rightarrow 25=a+10-b)\Rightarrow a=15+b$ *	M1A1*
		(2)
(b)	$9=a+10+b\Rightarrow a=...$ or $b=....$	M1
	$a=7,\ b=-8$	A1A1
		(3)
(c)	$\left(\frac{8}{5},7\right)$	B1ftB1
		(2)
(d)	$15-5x=-2x^3+5x^2+4x-3\Rightarrow 2x^3-5x^2-9x+18=0$	M1
	$2x^3-5x^2-9x+18=(x+2)(2x^2-9x+9)$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

Question Number	Scheme	Marks
8 (i)	States or uses $\operatorname{cosec}\theta=\frac{1}{\sin\theta}$	B1
	Uses both $\operatorname{cosec}\theta=\frac{1}{\sin\theta}$ and $\sin 2\theta=2\sin\theta\cos\theta$	M1
	$3\operatorname{cosec}\theta=8\cos\theta\Rightarrow\sin 2\theta=\frac{3}{4}$	A1
	$\Rightarrow\theta=\frac{1}{2}\arcsin\left(\frac{3}{4}\right)=$ awrt 0.424, awrt 1.15	M1 A1
		(5)
(ii)	$\frac{\tan 2x-\tan 70°}{1+\tan 2x\tan 70°}=-\frac{3}{8}\Rightarrow\tan(2x-70°)=-\frac{3}{8}$	M1 A1
	Correct order of operations $x=\frac{\arctan\left(-\frac{3}{8}\right)+70°}{2}$	dM1
	awrt 24.7°, awrt 114.7°	A1
		(4)
		(9 marks)

Question Number	Scheme	Marks
2. (a)	$f(1)=4\times1^3+2\times1^2-12=-6$ AND $f(2)=4\times2^3+2\times2^2-12=28$	M1
	States change of sign, continuous and hence root	A1
		(2)
(b)	$4x^3+2x^2-12=0\Rightarrow x^2(4x+2)=12$	M1
	$\Rightarrow x^2=\dfrac{12}{4x+2}=\dfrac{6}{2x+1}\Rightarrow x=\sqrt{\dfrac{6}{2x+1}}$	A1
		(2)
(c) (i)	$\left(x_2=\sqrt{\dfrac{'6'}{2+1}}=1.4...\right),\quad x_3=1.2519$	M1, A1
(ii)	$\alpha=1.2934$	B1
		(3)
		(7 marks)

Question Number	Scheme	Marks
1(a)	$gf(1)=g\left(\dfrac{2(1)}{3\times1+1}\right)=4-\left(\dfrac{2(1)}{3\times1+1}\right)^2$	M1
	$=\dfrac{15}{4}$ oe	A1
		(2)
(b)	$f(x)\geq 0$ or $f(x)<\dfrac{2}{3}$	B1
	$0\leq f(x)<\dfrac{2}{3}$	B1
		(2)
(c)	$y=\dfrac{2x}{3x+1}\Rightarrow 3xy+y=2x\Rightarrow 3xy-2x=-y\Rightarrow x(3y-2)=-y$ or $x=\dfrac{2y}{3y+1}\Rightarrow 3xy+x=2y\Rightarrow 3xy-2y=-x\Rightarrow y(3x-2)=-x$	M1
	$\Rightarrow f^{-1}(x)=\dfrac{x}{2-3x}$	A1
		(2)
(d)	$f^{-1}(x)=f(x)$ **or** $f^{-1}(x)=x$ **or** $f(x)=x$ $"\dfrac{x}{2-3x}"=\dfrac{2x}{3x+1}$ **or** $"\dfrac{x}{2-3x}"=x$ **or** $\dfrac{2x}{3x+1}=x$ $\Rightarrow x(3x+1)=2x(2-3x)$ **or** $x=x(2-3x)$ **or** $2x=x(3x+1)$ $\Rightarrow x=...$	M1
	$x=0,\ \dfrac{1}{3}$	A1
		(2)
		Total 8

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)
	$\begin{matrix} a-b=8 \\ a+b=14 \end{matrix} \Rightarrow a=...$ or $b=...$	**dd**M1
	$a=11,\ b=3$	A1
		(4)
		(11 marks)

Question Number	Scheme	Marks
5(a)	$(A=)8$	B1
		(1)
(b)	$16=10+"8"\mathrm{e}^{-Bt}\Rightarrow \mathrm{e}^{-Bt}=...$	M1
	$\mathrm{e}^{-45B}="\frac{3}{4}"\Rightarrow -45B=\ln"\frac{3}{4}"\Rightarrow B=...$	**d**M1
	$B=$ awrt 0.00639	A1
		(3)
(c)	$\frac{\mathrm{d}T}{\mathrm{d}t}=-"8"\times\frac{1}{45}\ln\left(\frac{4}{3}\right)\times \mathrm{e}^{-\frac{1}{45}\ln\left(\frac{4}{3}\right)\times 2}=...$	M1
	$=\ -0.0505$	A1
		(2)
(d)	The temperature has a (lower) limit of 10 °C **or** $5=10+"8"\mathrm{e}^{-Bt}\Rightarrow \mathrm{e}^{-Bt}=-\frac{5}{"8"}$ e.g. which is not possible or cannot be solved or you cannot find the log of a negative number	B1
		(1)
		(7 marks)

8(a)	$\tan 3x \equiv \tan(2x+x) \equiv \frac{\tan 2x + \tan x}{1-\tan 2x \tan x}$ or e.g. $\tan 3x \equiv \frac{\sin 3x}{\cos 3x} \equiv \frac{\sin(2x+x)}{\cos(2x+x)} \equiv \frac{\sin 2x\cos x + \cos 2x \sin x}{\cos 2x \cos x - \sin 2x \sin x} \equiv \frac{\tan 2x + \tan x}{1-\tan 2x \tan x}$	M1
	$\frac{\tan 2x + \tan x}{1-\tan 2x\tan x} \equiv \frac{\frac{2\tan x}{1-\tan^2 x}+\tan x}{1-\frac{2\tan x}{1-\tan^2 x}\tan x}$	dM1
	$\frac{\frac{2\tan x}{1-\tan^2 x}+\tan x}{1-\frac{2\tan x}{1-\tan^2 x}\tan x} \equiv \frac{2\tan x + \tan x - \tan^3 x}{1-\tan^2 x - 2\tan^2 x}$ $\frac{3\tan x - \tan^3 x}{1-3\tan^2 x}$ *	A1*
		(3)

(b)	$\frac{3\tan\theta - \tan^3\theta}{1-3\tan^2\theta} = 2\sec^2 3\theta - 8 \Rightarrow \tan 3\theta = 2\sec^2 3\theta - 8$ $\Rightarrow \tan 3\theta = 2(1+\tan^2 3\theta) - 8$	M1
	$\Rightarrow 2\tan^2 3\theta - \tan 3\theta - 6 = 0$ or e.g. $\Rightarrow 2\tan^2 3\theta - \tan 3\theta = 6$	A1
	$(2\tan 3\theta + 3)(\tan 3\theta - 2) = 0 \Rightarrow \tan 3\theta = -\frac{3}{2}, 2$ $\tan 3\theta = -\frac{3}{2} \Rightarrow 3\theta = ... \Rightarrow \theta = ...$ or $\tan 3\theta = 2 \Rightarrow 3\theta = ... \Rightarrow \theta = ...$	dM1
	$\theta = 0.37, 0.72, 1.42$	A1A1
		(5)
		Total 8

7.(a)	States or implies that $A = 2\,500$	B1
	$10000 = 2500e^{k\times 8} \Rightarrow 8k = \ln 4 \Rightarrow k = ...$	M1
	$\Rightarrow k = \frac{1}{8}\ln 4$ or awrt 0.1733	A1
		(3)
(b)	$\frac{dN}{dt} = 60000 \times -0.6e^{-0.6\times 5} = -1792$ So decrease is 1790	M1, A1
		(2)
(c)	$60000e^{-0.6t} = 2500e^{0.1733t}$	M1
	$24 = e^{0.1733t+0.6t} \Rightarrow 0.1733t + 0.6t = \ln 24 \Rightarrow t = ...$	dM1
	$T = 4.11$	A1
		(3)
		8 marks

Question Number	Scheme	Marks
9(a)	$4\sin\theta\cos\theta = 2\sin 2\theta$	B1
	e.g. $\Rightarrow 6\sin^2\theta\cot 2\theta + 2\sin 2\theta = (3 - 3\cos 2\theta)\dfrac{\cos 2\theta}{\sin 2\theta} + 2\sin 2\theta$	M1A1
		(3)
(b)	$3\cot 2\theta - 14 = 6\sin^2\theta\cot 2\theta + 4\sin\theta\cos\theta$	
	e.g. $\Rightarrow 3\cot 2\theta\sin 2\theta - 14\sin 2\theta = (3 - 3\cos 2\theta)\cos 2\theta + 2\sin^2 2\theta$	M1
	$\Rightarrow -14\sin 2\theta = -3(1 - \sin^2 2\theta) + 2\sin^2 2\theta$	M1
	$5\sin^2 2\theta + 14\sin 2\theta - 3 = 0$ *	A1*
		(3)
(c)	$(\sin 2x =)\dfrac{1}{5} \Rightarrow x = \ldots$	M1
	$x =$ awrt $5.8°$, awrt $84.2°$	A1A1
		(3)
		(9 marks)

10(a)(i)	$(y =)10 + k$	B1
(ii)	$x = \dfrac{10}{k}$ **or** $y = k$	B1
	$x = \dfrac{10}{k}$ **and** $y = k$	B1
		(3)
(b)	$kx - 10 + k = 2k \Rightarrow x = \ldots$ **or** $-kx + 10 + k = 2k \Rightarrow x = \ldots$	M1
	$kx - 10 + k = 2k \Rightarrow x = \ldots$ **and** $-kx + 10 + k = 2k \Rightarrow x = \ldots$	dM1
	$x \leqslant \dfrac{10 - k}{k}$ or $x \geqslant \dfrac{10 + k}{k}$ oe	A1
		(3)
(c)	$k > 3$	B1
	Maximum value of k occurs when $y = 3x + 1$ passes through vertex e.g. when $"k" = 3 \times "\dfrac{10}{k}" + 1 \Rightarrow k = \ldots$ **See below for alternative approaches.**	M1
	$k^2 - k - 30 = 0 \Rightarrow (k + 5)(k - 6) = 0 \Rightarrow k = 6$ So **maximum** k is 6	A1
	$3 < k < 6$	A1
		(4)
		Total 10

1. (a)	$f(x) = 2\sec x + 6x - 3$	
	$f(0.1) = -0.39 \qquad f(0.2) = 0.24$	M1
	States change of sign, continuous and hence root	A1
		(2)
(b)	Sets $f(x) = 0$, uses $\sec x = \dfrac{1}{\cos x}$ and makes x of $6x$ the subject	
	$\Rightarrow 6x = 3 - \dfrac{2}{\cos x} \Rightarrow x = \dfrac{1}{2} - \dfrac{1}{3\cos x}$ *	B1*
		(1)
(c)	(i) $x_2 = \dfrac{1}{2} - \dfrac{1}{3\cos 0.15} = 0.16..$	M1
	$x_2 =$ awrt 0.1629	A1
	(ii) $\alpha = 0.1622$	A1
		(3)
		(6 marks)