1. (a)	$g(3)=-265, \quad g(4)=3104$	M1
	States change of sign, continuous and hence root in $[3,4]$	A1
		(2)
(b)	$x_2=\sqrt[6]{1000-2\times 3} \quad =3.1591$	M1 A1
	$(\alpha=)3.1589$	A1
		(3)
		(5 marks)

Question Number	Scheme	Marks
2(a)	$f(1)=\dfrac{2(1)^2+3(1)-4}{e^1}-\dfrac{1}{1^2}=\ldots$ **and** $f(2)=\dfrac{2(2)^2+3(2)-4}{e^2}-\dfrac{1}{(2)^2}=\ldots$	M1
	$f(1)=-0.6(321\ldots)[<0]$ **and** $f(2)=1.(103\ldots)[>0]$ $\Rightarrow$ There is a sign change and f(*x*) is continuous over the interval hence root (in the interval $[1,2]$)	A1
		(2)
(b)	$\dfrac{2x^2+3x-4}{e^x}-\dfrac{1}{x^2}=0\Rightarrow 2x^4+3x^3=e^x+4x^2$	M1
	$x^3(2x+3)=e^x+4x^2\Rightarrow x=\sqrt[3]{\dfrac{e^x+4x^2}{2x+3}}$ *	A1*
		(2)
(c) **(i)**	$x_2=\sqrt[3]{\dfrac{e^1+4(1)^2}{2(1)+3}}=\text{awrt }1.1035\Rightarrow x_3=\text{awrt }1.1484$	M1A1
(ii)	1.1813	A1
		(3)
		(7 marks)

8	$h=1.5x-0.5x\,e^{0.02x}$	
(a)	$0=1.5d-0.5d\,e^{0.02d}\Rightarrow e^{0.02d}=3$	M1
	$\Rightarrow 0.02d=\ln 3\Rightarrow d=54.93$	dM1 A1
		(3)
(b)	$\left(\dfrac{dh}{dx}=\right)1.5-\left(0.5\,e^{0.02x}+0.5x\times 0.02\,e^{0.02x}\right)$	M1A1
	Sets $0=1.5-0.5\,e^{0.02x}-0.5x\times 0.02\,e^{0.02x}\Rightarrow e^{0.02x}(0.5+0.5x\times 0.02)=1.5$	
	$\Rightarrow e^{0.02x}=\dfrac{1.5}{(0.5+0.5x\times 0.02)}$	dM1
	$\Rightarrow e^{0.02x}=\dfrac{1.5}{(0.5+0.5x\times 0.02)}=\dfrac{150}{50+x}\Rightarrow x=50\ln\left(\dfrac{150}{50+x}\right)$ *	A1*
		(4)
(c)	(i) awrt 31.43	M1 A1
	(ii) awrt 30.88 metres **(including units)**	A1
		(3)
		(10 marks)

7(a)	$y=e^{-x^2}\sin 3x \Rightarrow \frac{dy}{dx}=3e^{-x^2}\cos 3x-2xe^{-x^2}\sin 3x$	M1A1
	$3e^{-x^2}\cos 3x-2xe^{-x^2}\sin 3x=0\Rightarrow 3\cos 3x-2x\sin 3x=0$ $\Rightarrow 3\cos 3x=2x\sin 3x\Rightarrow \tan 3x=\frac{3}{2x}$	dM1
	$x=\frac{1}{3}\arctan\left(\frac{3}{2x}\right)$ *	A1*
		(4)
(b)(i)	$x_1=0.4\Rightarrow x_2=\frac{1}{3}\arctan\left(\frac{3}{2\times 0.4}\right)$	M1
	$(x_2=)0.4367$	A1
(ii)	$(x_4=)0.4307$	A1
		(3)

(c)	e.g. $f(x)=x-\frac{1}{3}\arctan\left(\frac{3}{2x}\right)$ $f(0.4305)=0.4305-\frac{1}{3}\arctan\left(\frac{3}{2\times 0.4305}\right)\left(=6.38\times 10^{-5}\right)$ $f(0.4295)=0.4295-\frac{1}{3}\arctan\left(\frac{3}{2\times 0.4295}\right)\left(=-1.141...\times 10^{-3}\right)$ or e.g. $f(x)=3e^{-x^2}\cos 3x-2xe^{-x^2}\sin 3x$ $f(0.4305)=3e^{-(0.4305)^2}\cos 3(0.4305)-2(0.4305)e^{-(0.4305)^2}\sin 3(0.4305)\left(=-4.968...\times 10^{-4}\right)$ $f(0.4295)=3e^{-(0.4295)^2}\cos 3(0.4295)-2(0.4295)e^{-(0.4295)^2}\sin 3(0.4295)\left(=8.885...\times 10^{-3}\right)$	M1
	Sign change therefore x is 0.430 to 3dp	A1
		(2)
		Total 9

	$f(x)=2\sec x+6x-3$	
1. (a)	$f(0.1)=-0.39$ $\quad f(0.2)=0.24$	M1
	States change of sign, continuous and hence root	A1
		(2)
(b)	Sets $f(x)=0$, uses $\sec x=\frac{1}{\cos x}$ and makes x of $6x$ the subject	
	$\Rightarrow 6x=3-\frac{2}{\cos x}\Rightarrow x=\frac{1}{2}-\frac{1}{3\cos x}$ *	B1*
		(1)
(c)	(i) $x_2=\frac{1}{2}-\frac{1}{3\cos 0.15}=0.16..$	M1
	$x_2=$ awrt 0.1629	A1
	(ii) $\alpha=0.1622$	A1
		(3)
		(6 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)	$(f(1)=)1-5+e=-1.281...<0$ $(f(2)=)2^2-5\times2+e^2=1.389...>0$	M1
	As there is a change of sign and $f(x)$ is continuous over the interval $[1, 2]$ then there is a root *	A1*
		(2)
(b)(i)	$x_2=\sqrt{5\times1-e^1}=\text{awrt}\,1.5105$	M1A1
(ii)	$\alpha=\text{awrt }1.7340$	A1
		(3)
		(5 marks)

Question Number	Scheme	Marks
2(a)	$(f(2)=)2^4-5(2)^2+4(2)-7=-3<0$ **and** $(f(3)=)3^4-5(3)^2+4(3)-7=41>0$	M1
	There is a change of sign and $f(x)$ is continuous so there is a root (in the interval) *	A1*
		(2)
(b)	$x^3=\dfrac{5x^2-4x+7}{x}\Rightarrow x=\sqrt[3]{\dfrac{5x^2-4x+7}{x}}$ *	B1*
		(1)
(c)(i)	$x_2=\sqrt[3]{\dfrac{5(2)^2-4(2)+7}{2}}$	M1
	$=\text{awrt }2.1179$	A1
(ii)	$\alpha=\text{awrt }2.1565$	A1
		(3)
		(6 marks)