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

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

(c)	e.g. $f(x) = x - \dfrac{1}{3}\arctan\left(\dfrac{3}{2x}\right)$ $f(0.4305) = 0.4305 - \dfrac{1}{3}\arctan\left(\dfrac{3}{2\times 0.4305}\right)\left(= 6.38\times 10^{-5}\right)$ $f(0.4295) = 0.4295 - \dfrac{1}{3}\arctan\left(\dfrac{3}{2\times 0.4295}\right)\left(= -1.141...\times 10^{-3}\right)$ 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

Question Number	Scheme	Marks
3(a)	$\log_{10} y = \frac{5}{16}x + 1.5$	M1A1
		(2)
(b)	$\log_{10} y = "\frac{5}{16}"x + "1.5" \Rightarrow y = 10^{"\frac{5}{16}"x + "1.5"}$	M1
	$\Rightarrow y = 10^{"\frac{5}{16}"x} \times 10^{"1.5"}$	M1
	$y = 31.6 \times 2.05^x$	A1
		(3)
		Total 5

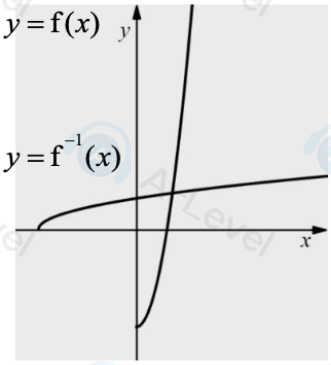
Question Number	Scheme	Marks
2(a)	$f(1) = \frac{2(1)^2 + 3(1) - 4}{e^1} - \frac{1}{1^2} = \ldots$ **and** $f(2) = \frac{2(2)^2 + 3(2) - 4}{e^2} - \frac{1}{(2)^2} = \ldots$	M1
	$f(1) = -0.6(321\ldots)[<0]$ **and** $f(2) = 1.(103\ldots)[>0]$ $\Rightarrow$ There is a sign change and f(x) is continuous over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

Question Number	Scheme	Marks
1 (a)	$(5,10)$	B1 B1 **(2)**
(b)	Attempts to solve e.g. $-2(x-5)+10...6x \Rightarrow x...\text{"}\frac{5}{2}\text{"}$ $x<\frac{5}{2}$ o.e.	M1 A1 **(2)**
(c)	$(7,30)$	B1ft, B1ft **(2)** **(6 marks)**

6.(a)	$(2,-10)$	B1 B1 **(2)**
(b)	$ff(0)=f(-4)=...$ $=8$	M1 A1cso **(2)**
(c)	Attempts to solve $-3(x-2)-10=5x+10 \Rightarrow x=...$ $x>-\frac{7}{4}$ only	M1 A1 **(2)**
(d)	$x\left(\text{or } \lvert x\rvert\right)=\frac{16}{3}$ Attempts $3(\lvert x\rvert-2)-10=0 \Rightarrow \lvert x\rvert=k,\ k>0$ or $3(-x-2)-10=0 \Rightarrow x=-k$ or $3(x-2)-10=0 \Rightarrow x=k \Rightarrow x=-k$ $x=\left(\frac{16}{3}\text{ and }\right)-\frac{16}{3}$ with no other values	B1 M1 A1 **(3)** **(9 marks)**

5 (a)	$f^{-1}(22) \Rightarrow 2+5\ln x = 22 \Rightarrow \ln x = 4 \Rightarrow (x=)\ e^4$	M1 A1 **(2)**
(b)	$g(x) = \frac{6x-2}{2x+1} \Rightarrow g'(x) = \frac{6(2x+1)-2(6x-2)}{(2x+1)^2}$	M1 A1
	States $(g'(x)=)\ \frac{10}{(2x+1)^2} > 0$ hence increasing *	A1* **(3)**
(c)	$y = \frac{6x-2}{2x+1} \Rightarrow 2xy+y = 6x-2 \Rightarrow 2xy-6x = -y-2$	M1
	$\Rightarrow x = \frac{-y-2}{2y-6}$ So $g^{-1}(x) = \frac{-x-2}{2x-6}$ o.e.	A1
	Domain $0 < x < 3$	B1 **(3)**
(d)	Range fg is $fg < 2+5\ln 3$	M1, A1 **(2)**
		(10 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 $b = 1.12$	A1
	$V = 100\times(1.12)^t$	A1
		(3)
(c)	$\frac{dV}{dt} = 100\times\ln 1.12\times(1.12)^t \quad (=11.33(1.12)^t)$	B1ft
	$100\times\ln 1.12\times(1.12)^T = 50 \Rightarrow (1.12)^T = \frac{50}{100\ln 1.12}$	M1
	$(T=)\ \log_{1.12}\left(\frac{50}{100\ln 1.12}\right) = \ldots$	dM1
	$(T=)13$	A1
		(4)
		(9 marks)

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

Question Number	Scheme	Marks
6(a)	$\theta = 75,\ t = 0 \Rightarrow 75 = 21 + A \Rightarrow A = \ldots$	M1
	$A = 54$	A1
		(2)
(b)	$\theta = 21 + 54e^{-kt} \Rightarrow 25 = 21 + 54e^{-5k}$	M1
	$54e^{-5k} = 4 \Rightarrow e^{-5k} = \frac{2}{27} \Rightarrow -5k = \ln\frac{2}{27} \Rightarrow k = \ldots$	M1
	$k = -\frac{1}{5}\ln\frac{2}{27} = 0.521$	A1
		(3)
(c)	$\theta = 21 + 54e^{-0.521t} \Rightarrow \frac{d\theta}{dt} = -28.1\ldots e^{-0.521t}$	M1
	$-28.1\ldots e^{-0.521T} = -9 \Rightarrow e^{-0.521T} = \frac{9}{28.1\ldots} \Rightarrow -0.521T = \ln\left(\frac{9}{28.1\ldots}\right)$ $\Rightarrow T = \ln\left(\frac{9}{28.1\ldots}\right) \div -0.521$	dM1
	$= 2.19$	A1
		(3)

6(a)	$\log_{10} S = 4.5 - 0.006 \times 2 \Rightarrow S = 10^{4.5-0.006\times 2} = 30800\text{km}^2$	M1A1
		(2)
(b)	$\log_{10} S = 4.5 - 0.006t \Rightarrow S = 10^{4.5-0.006t}$ (or $p = 10^{4.5}$ or $q = 10^{-0.006}$)	M1
	$S = 10^{4.5-0.006t} = 10^{4.5} \times \left(10^{-0.006}\right)^t$ (or $p = 10^{4.5}$ and $q = 10^{-0.006}$)	dM1
	$S = 31600 \times (0.986)^t$	A1
		(3)
(c)	E.g. The proportion of area covered by coral reefs retained from year to year.	B1
		(1)
		(6 marks)