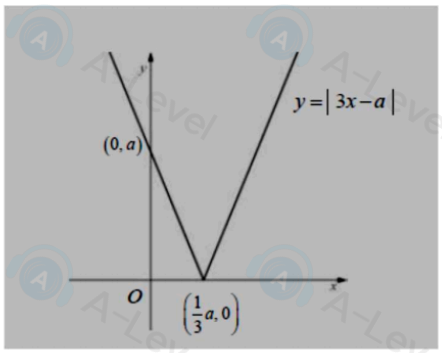
Question Number	Scheme	Marks
1(a)	$f(x)$ „ 9	B1
		(1)
(b)	$fg(1.5)=f\left(\frac{3}{2\times1.5+1}\right)=9-\left(\frac{3}{2\times1.5+1}\right)^2$	M1
	$=\frac{135}{16}$	A1
		(2)
(c)	$g(x)=\frac{3}{2x+1}\Rightarrow g^{-1}(x)=\frac{3-x}{2x}$	M1 A1
	$0<x$ „ 3	B1
		(3)
		Total 6

7 (a)(i)

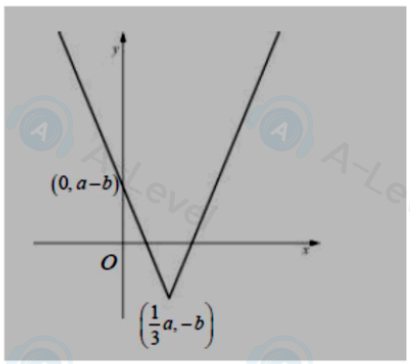


Shape B1

Vertex $\left(\frac{1}{3}a, 0\right)$ B1

y intercept $(0, a)$ B1

(a)(ii)



Shape B1ft

Vertex $\left(\frac{1}{3}a, -b\right)$ B1ft

y intercept $(0, a-b)$ B1ft

(6)

(b)

Attempts to solve $-3x+a-b=5x\Rightarrow x=...$ M1

$\Rightarrow x=\frac{a-b}{8}$ ONLY A1

(2)

(8 marks)

5 (i)	States $x = 2$	B1
	$\sqrt{3}\sec x + 2 = 0 \Rightarrow \cos x = -\frac{\sqrt{3}}{2} \Rightarrow x = ...$	M1
	$x = \frac{5\pi}{6}$	A1
		(3)
(ii)	Attempts to use $\cos 2\theta = 1 - 2\sin^2\theta$	M1
	$6\sin^2\theta + 10\sin\theta - 3 = 0$	A1
	$\sin\theta = \frac{-5 \pm \sqrt{43}}{6} \left(= -1.926..., 0.2595...\right) \Rightarrow \theta = \arcsin(...)$	M1
	$\theta = 15.0°, 165°$	A1
		(4)
		(7 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
1 (a)	$(5, 10)$	B1 B1
		(2)
(b)	Attempts to solve e.g. $-2(x-5) + 10...6x \Rightarrow x...\text{"}\frac{5}{2}\text{"}$	M1
	$x < \frac{5}{2}$ o.e.	A1
		(2)
(c)	$(7, 30)$	B1ft, B1ft
		(2)
		(6 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

8. (a)	$f'(x) = 6(2x+1)^2 e^{-4x} - 4(2x+1)^3 e^{-4x}$	M1 A1
	$= 2(2x+1)^2 e^{-4x}\{3 - 2(2x+1)\}$	dM1
	$= 2(2x+1)^2(1-4x)e^{-4x}$	A1
		(4)
(b)	Sets $f'(x) = 0 \Rightarrow x = -\frac{1}{2}, \frac{1}{4}$	B1
	Either $f\left("-\frac{1}{2}"\right) = ...$ or $f\left("\frac{1}{4}"\right) = ...$	M1
	Both $\left(-\frac{1}{2}, 0\right)$ and $\left(\frac{1}{4}, \frac{27}{8e}\right)$	A1
		(3)
(c)	$\left(\frac{9}{4}, \frac{27}{e}\right)$	B1ft B1ft
		(2)
		9 marks

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

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)	$x_2=\sqrt{5\times1-e^1}=$ awrt 1.5105	M1A1
(ii)	$\alpha=$ awrt 1.7340	A1
		(3)
		(5 marks)

2 (a)	$x=2y^2+5y-6$	
	$\frac{dx}{dy}=4y+5\Rightarrow\frac{dy}{dx}=\frac{1}{4y+5}$	M1, A1
		(2)
(b)	Sets their $4y+5=0\Rightarrow y=-\frac{5}{4}$	M1
	Substitutes their $y=-\frac{5}{4}$ into $x=2y^2+5y-6$ to find x	dM1
	$\left(-\frac{73}{8}, -\frac{5}{4}\right)$	A1
		(3)

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