9 (a)	$f'(x)=\dfrac{(2x+1)\times(12x+4)-2\left(6x^2+4x-2\right)}{(2x+1)^2}$	M1 A1
	$=\dfrac{12x^2+12x+8}{(2x+1)^2}$ o.e	A1
		(3)
(b)	At $x=2 \Rightarrow f'(x)=\dfrac{12\times2^2+12\times2+8}{(2\times2+1)^2}=\left(\dfrac{16}{5}\right)$	M1
	Full method of normal $y-6=-\dfrac{5}{16}(x-2)$	dM1
	$16y-96=-5x+10 \Rightarrow \ 16y+5x=106$ *	A1*
		(3)
(c)	Any correct value $A=3, B=\dfrac{1}{2}$ *or* $D=-\dfrac{5}{2}$	B1
	$6x^2+4x-2=(Ax+B)(2x+1)+D \Rightarrow$ Values of A, B and D	M1
	$3x+\dfrac{1}{2}+\dfrac{-5/2}{2x+1}$ o.e	A1
		(3)
(d)	$\displaystyle\int 3x+\frac{1}{2}+\frac{-5/2}{2x+1}\,dx=\frac{3}{2}x^2+\frac{1}{2}x-\frac{5}{4}\ln(2x+1)$	M1, A1 ft
	Area under curve $=\left[\dfrac{3}{2}x^2+\dfrac{1}{2}x-\dfrac{5}{4}\ln(2x+1)\right]_{\frac{1}{3}}^{2}=\left(\dfrac{3}{2}\times2^2+\dfrac{1}{2}\times2-\dfrac{5}{4}\ln(5)\right)-\left(\dfrac{3}{2}\times\left(\dfrac{1}{3}\right)^2+\dfrac{1}{2}\times\left(\dfrac{1}{3}\right)-\dfrac{5}{4}\ln\left(\dfrac{5}{3}\right)\right)$	dM1
	Area of $R=\displaystyle\int_{\frac{1}{3}}^{2}3x+\frac{1}{2}+\frac{-5/2}{2x+1}dx+\frac{1}{2}\times6\times\left(\frac{106}{5}-2\right)$	M1
	Area of $R=\dfrac{964}{15}-\dfrac{5}{4}\ln3$	A1
		(5)
		Total 14

9(b)	$\frac{1}{3}x^3-4x$	**B1 FT**	Follow *their* quotient of form Ax^2+B.
	Obtain $p\tan^{-1}qx$ where $q=2$ or $q=\frac{1}{2}$	**M1**	
	Obtain $16\tan^{-1}\frac{1}{2}x$	**A1 FT**	Follow *their* constant remainder, i.e. $\left(\frac{\textit{their}\text{ constant remainder}}{2}\right)\tan^{-1}\frac{1}{2}x$.
	Use limits correctly in an expression containing $p\tan^{-1}qx$ where $q=2$ or $q=\frac{1}{2}$ and rx^3+sx	**M1**	Terms need not be evaluated, e.g. $\left[8\sqrt{3}-8\sqrt{3}\right]+16\tan^{-1}\sqrt{3}-\left(\frac{8}{3}-8+16\tan^{-1}1\right)$ or $\frac{8}{3}-8$ can be $-\frac{16}{3}$, $16\tan^{-1}\sqrt{3}$ can be $\frac{16\pi}{3}$, $16\tan^{-1}1$ can be 4π.
	Obtain $\frac{4}{3}(\pi+4)$ from full and correct working	**A1**	AG
		5	

3(a)	$\log_{10} y = \pm\frac{2}{3.5}\log_{10} x - 2$	M1
	$\log_{10} y = -\frac{4}{7}\log_{10} x - 2$	A1
		(2)

Question	Answer	Marks	Guidance
8(a)	Use quotient or product rule	**M1**	
	Obtain correct derivative in any form	**A1**	
	Equate derivative to zero and solve for x	**M1**	
	Obtain $x = \sqrt[4]{e}$ and $y = \frac{1}{4e}$, or exact equivalents	**A1**	
		4	

8(b)	Commence integration and reach $ax^{-3}\ln x + b\int x^{-3}.\ \frac{1}{x}\ dx$	***M1**	
	Obtain $-\frac{1}{3}x^{-3}\ln x + \frac{1}{3}\int x^{-3}.\ \frac{1}{x}\ dx$	**A1**	OE
	Complete integration and obtain $-\frac{1}{3}x^{-3}\ln x - \frac{1}{9}x^{-3}$	**A1**	
	Substitute limits correctly, having integrated twice	**DM1**	
	Obtain answer $\frac{1}{9} - \frac{1}{3}a^{-3}\ln a - \frac{1}{9}a^{-3}$	**A1**	OE
	Justify the given statement	**A1**	
		6	

Question	Answer	Marks	Guidance
10(a)	Use correct product or quotient rule	***M1**	$\frac{dy}{dx} = \left(-\frac{1}{2}\right)(2-x)e^{-\frac{1}{2}x} - e^{-\frac{1}{2}x}$ M1 requires at least one of derivatives correct
	Obtain correct derivative in any form	**A1**	
	Equate derivative to zero and solve for x	**DM1**	
	Obtain $x = 4$	**A1**	ISW
	Obtain $y = -2e^{-2}$, or exact equivalent	**A1**	
		5	

Question	Answer	Marks	Guidance
10(b)	Commence integration and reach $a(2-x)e^{-\frac{1}{2}x} + b\int e^{-\frac{1}{2}x}dx$	***M1**	Condone omission of dx $-2(2-x)e^{-\frac{1}{2}x} + 4e^{-\frac{1}{2}x}$ or $2xe^{-\frac{1}{2}x}$
	Obtain $-2(2-x)e^{-\frac{1}{2}x} - 2\int e^{-\frac{1}{2}x}dx$	**A1**	OE
	Complete integration and obtain $2xe^{-\frac{1}{2}x}$	**A1**	OE
	Use correct limits, $x = 0$ and $x = 2$, correctly, having integrated twice	**DM1**	Ignore omission of zeros and allow max of 1 error
	Obtain answer $4e^{-1}$, or exact equivalent	**A1**	ISW

Question	Answer	Marks	Guidance
4	Commence integration and reach $ax\cos\frac{1}{2}x+b\int\cos\frac{1}{2}x\,\mathrm{d}x$	*M1	
	Obtain $-2x\cos\frac{1}{2}x+2\int\cos\frac{1}{2}x\,\mathrm{d}x$	A1	OE
	Complete integration obtaining $-2x\cos\frac{1}{2}x+4\sin\frac{1}{2}x$	A1	OE
	Use limits correctly, having integrated twice	DM1	
	Obtain answer $2+\frac{\sqrt{3}}{3}\pi$, or exact equivalent	A1	
		5	

Question	Answer	Marks	Guidance
7(a)	$\frac{\mathrm{d}u}{\mathrm{d}x}=-\sin x$	B1	SOI
	Use double angle formula and substitute for x and dx throughout the integral	M1	All x's must be removed, can be coefficient errors provided 2 seen in working.
	Obtain $\pm\int 2ue^{2u}\mathrm{d}u$	A1	Limits may be omitted, or left as 0 and π, during the change of variable stage.
	Justify new limits and obtain $\int_{-1}^{1}2ue^{2u}\mathrm{d}u$ from correct working	A1	AG Must see $x = 0$, $u = 1$ and $x = \pi$, $u = -1$. Inequalities alone e.g. $0 \leqslant x \leqslant \pi$ and $1 \leqslant u \leqslant -1$ or $-1 \leqslant u \leqslant 1$ for limits are insufficient A0 If sign in expression and order of limits incorrect then A0. If negative sign is present in the integrand then this can be removed and limits introduced in correct order in a single step.
		4	

Question	Answer	Marks	Guidance
7(b)	Commence integration and reach $aue^{2u}+b\int e^{2u}\mathrm{d}u$, where $ab\neq 0$, $b<0$	M1*	Condone dx.
	Complete integration and obtain $ue^{2u}-\frac{1}{2}e^{2u}$	A1	OE Allow $(2\,u\frac{1}{2}e^{2u})-\frac{1}{2}e^{2u}$.
	Use correct limits correctly in $cue^{2u}+de^{2u}$ having integrated twice or in $c\cos x\,e^{2\cos x}+de^{2\cos x}$	DM1	1 and −1 for u, 0 and π for x e.g. $ce^2+de^2-(-ce^{-2}+de^{-2})$. Not decimals. Allow one sign error at most in going from $cue^{2u}+de^{2u}$ or $c\cos x\,e^{2\cos x}+de^{2\cos x}$ to $ce^2+de^2-(-ce^{-2}+de^{-2})$. $[e^2-½e^2-(-e^{-2}-½e^{-2})]$ Complete reversal of sign by converting back to cos x and not making $x = 0$ upper limit is DM0 A0.
	Obtain $\frac{1}{2}e^2+\frac{3}{2}e^{-2}$	A1	ISW Or equivalent 2-term expression e.g. $\frac{e^4+3}{2e^2}$ or $\frac{1}{2}\left(e^2+\frac{3}{e^2}\right)$.
		4	

Question	Answer	Marks	Guidance
3	Commence integration by parts and reach $x\tan x \pm \int \tan x.1\,\mathrm{d}x$	*M1	
	Use a correct method to integrate tan x	M1	
	Obtain integral $x\tan x - \ln\sec x$, or equivalent	A1	
	Use limits correctly, having integrated twice	DM1	
	Obtain answer $\frac{1}{4}\pi - \frac{1}{2}\ln 2$, or exact equivalent	A1	
		5	