Question Number	Scheme	Marks
9 (a)	Uses $\tan\theta = \dfrac{\sin\theta}{\cos\theta} \rightarrow$ $\cos\theta - 1 = 4\sin\theta \dfrac{\sin\theta}{\cos\theta}$	M1
	$\cos^2\theta - \cos\theta = 4\sin^2\theta$ oe	A1
	Uses $\sin^2\theta = 1 - \cos^2\theta \rightarrow$ $\cos^2\theta - \cos\theta = 4\left(1 - \cos^2\theta\right)$	M1
	$5\cos^2\theta - \cos\theta - 4 = 0$ *	A1 *
		(4)
(b)	$(5\cos 2x + 4)(\cos 2x - 1) = 0$	M1
	Critical values of $-\dfrac{4}{5}, 1$	A1
	Correct method to find x from their $\cos 2x = -\dfrac{4}{5}$	dM1
	$x = 0, 1.25$	A1
		(4)
		(8 marks)

Notes

(a)

M1 Uses $\tan\theta = \dfrac{\sin\theta}{\cos\theta}$ oe in their $\cos\theta - 1 = 4\sin\theta\tan\theta$.

Condone slips in coefficients and the equation may have been adapted.

This may be implied by candidates who multiply by $\cos\theta$ and reach $\cos\theta - 1 = 4\sin\theta\tan\theta \Rightarrow \cos^2\theta - \cos\theta = 4\sin^2\theta$. This would be M1 A1

A1 Correct equation, without any fractional terms, in $\sin\theta$ and $\cos\theta$

If the identity $\sin^2\theta = 1 - \cos^2\theta$ is used before the multiplication by $\cos\theta$ then it will be for a correct equation, without any fractional terms, in $\cos\theta$ Condone incorrect notation $\cos\theta^2$ for $\cos^2\theta$

M1 Uses $\sin^2\theta = 1 - \cos^2\theta$ to produce an equation in just $\cos\theta$

A1* Proceeds to $5\cos^2\theta - \cos\theta - 4 = 0$ with no arithmetical or notational errors. Both identities must be seen to have been applied. Candidates cannot just go from $\cos^2\theta - \cos\theta = 4\sin^2\theta$ to the answer without any evidence of the appropriate identity. No mixed variables within the lines of the "proof"

Condone incomplete lines if it is part of their working.

Eg. $\cos^2\theta - \cos\theta = 4\sin^2\theta$

$= 4\left(1 - \cos^2\theta\right)$

An example of a notational error is $\cos\theta^2$ for $\cos^2\theta$ (Note that this would only lose the A1*)

(b)

M1 Attempts to find the critical values of the given quadratic by a correct method.

A1 Critical values of $-\dfrac{4}{5}, 1$. Allow this to be scored even if written as $\cos x = ...$ or even x.

Allow these to be written down (from a calculator)

Question Number	Scheme	Marks
	dM1 A correct method to find one value of x from their $\cos 2x = -\frac{4}{5}$ Look for correct order of operations. It is dependent upon the previous mark. This can be implied by awrt $1.5/71.6°$ or awrt $1.24/1.25$ (rads) A1 Both $x = 0$ and awrt 1.25 with no other values in the range $0 \leqslant x < \frac{\pi}{2}$. Condone 1.25 written as 0.398π. Condone if written as $\theta =$.. …… Answers **without working** can score all marks: Score M1 for one value and M1 A1 M1 A1 for both values and no others in the range.	

Question Number	Scheme	Marks
10 (a)	$\left(\mathrm{f}'(x)\right)=-\frac{72}{x^3}+2$	M1 A1
	Attempts to solve $\mathrm{f}'(x)=0\Rightarrow x=...$ via $x^{\pm n}=k,\quad k>0$	dM1
	$x>\sqrt[3]{36}$ oe	A1
		(4)
(b)	$\int \frac{36}{x^2}+2x-13\,\mathrm{d}x=-\frac{36}{x}+x^2-13x\,(+c)$	M1 A1
	Uses limits 9 and 2 $=\left(-\frac{36}{9}+9^2-13\times 9\right)-\left(-\frac{36}{2}+2^2-13\times 2\right)=0$ *	dM1 A1*
		(4)
(c)(i)	8	B1
(ii)	$\int_2^6\left(\frac{36}{x^2}+2x+k\right)\mathrm{d}x=0\Rightarrow\left[-\frac{36}{x}+x^2+kx\right]_2^6=0\Rightarrow(30+6k)-(-14+2k)=0$	
	$44+4k=0\Rightarrow k=-11$	M1 A1
		(3)
		(11 marks)

Notes

(a)

M1 Attempts $\mathrm{f}'(x)$ with one index correct. Allow for $x^{-2}\to x^{-3}$ or $2x\to 2$

A1 $\mathrm{f}'(x)=-\frac{72}{x^3}+2$ correct but may be unsimplified $\mathrm{f}'(x)=36\times -2x^{-3}+2$

dM1 Attempts to find where $\mathrm{f}'(x)=0$. Score for $x^n=k$ where $k>0$ and $n\neq\pm 1$ leading to $x=...$
Do not allow this to be scored from an equation that is adapted incorrectly to get a positive *k*.
Allow this to be scored from an attempt at solving $\mathrm{f}'(x)...0$ where **...** can be any inequality

A1 Achieves $x>\sqrt[3]{36}$ or $x>6^{\frac{2}{3}}$ Allow $x\geqslant\sqrt[3]{36}$ or $x\geqslant 6^{\frac{2}{3}}$ but not $x>\left(\frac{1}{36}\right)^{-\frac{1}{3}}$

We require an exact value but remember to isw. An answer of 3.302 usually implies the first 3 marks.

(b)

M1 For $x^n\to x^{n+1}$ seen on either $\frac{36}{x^2}$ or $2x$. Indices must be processed. eg $x^{1+1}\to x^2$

A1 $\int \frac{36}{x^2}+2x-13\,\mathrm{d}x=-\frac{36}{x}+x^2-13x$ which may be unsimplified. Eg $x^2\leftrightarrow\frac{2x^2}{2}$ Allow with + *c*

dM1 Substitutes 9 and 2 into their integral and subtracts either way around. Condone missing brackets
Dependent upon the previous M

A1* Completely correct integration with either embedded values seen or calculated values $(-40)-(-40)$
Note that this is a given answer and so the bracketing must be correct.