Question Number	Scheme	Marks
9.(i)	$3\sin(2\theta-10°)=1\Rightarrow(2\theta-10°)=\arcsin\left(\frac{1}{3}\right)$	M1
	$\theta=\frac{19.47+10}{2},\frac{160.53+10}{2}$	dM1
	$\theta=$ awrt $14.7°, 85.3°$	A1, A1 **(4)**
(ii) (a)	Writes $\frac{1}{\tan\alpha}-\sin\alpha=2\sin\alpha-\frac{1}{\tan\alpha}$ oe	M1
	$\frac{2}{\tan\alpha}=3\sin\alpha\Rightarrow\frac{2\cos\alpha}{\sin\alpha}=3\sin\alpha\Rightarrow2\cos\alpha=3\sin^2\alpha$ *	dM1 A1* **(3)**
(b)	$2\cos\alpha=3\sin^2\alpha\Rightarrow2\cos\alpha=3(1-\cos^2\alpha)$	M1
	$3\cos^2\alpha+2\cos\alpha-3=0$	A1
	Attempts to solve $3\cos^2\alpha+2\cos\alpha-3=0\Rightarrow\cos\alpha=\frac{-2\pm\sqrt{40}}{6}$ oe	dM1 A1
	$\alpha=5.517$ radians	A1 **(5)** **(12 marks)**

(i)

M1 For proceeding to $x=\arcsin\left(\frac{1}{3}\right)$ which may be implied by the sight of awrt $19.5°$ or awrt $160.5°$
(Allow awrt 0.340 (radians) for this mark)

dM1 For correct order of operations leading to one answer for θ. May be implied by $14.7°/14.8°$ but cannot be scored by adding 10 to an angle in radians but may be implied by awrt $0.257/0.258$ rad

A1 One of $\theta=$ awrt $14.7°, 85.3°$ ignore any others.

A1 Both of $\theta=$ awrt $14.7°, 85.3°$ and no others in the range.

Note that solutions based entirely on graphical or numerical methods are not acceptable so answers only will score 0 marks.

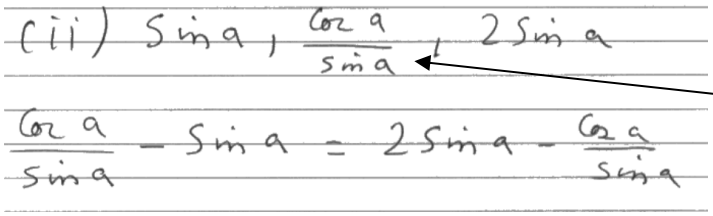
(ii)(a)

M1 Uses the terms of an AP to set up a correct equation. Eg $\frac{1}{\tan\alpha}-\sin\alpha=2\sin\alpha-\frac{1}{\tan\alpha}$, $\frac{\cos\alpha}{\sin\alpha}-\sin\alpha=2\sin\alpha-\frac{\cos\alpha}{\sin\alpha}$. They may also do $2\left(\frac{1}{\tan\alpha}-\sin\alpha\right)=2\sin\alpha-\sin\alpha$. Condone mixed variables and poor notation for the method marks.

dM1 Uses $\tan\alpha = \dfrac{\sin\alpha}{\cos\alpha}$ within an equation involving $\dfrac{1}{\tan\alpha}, \sin\alpha$ & $2\sin\alpha$. This mark can be implied but do not award if they just proceed straight to the final answer. It is dependent on the previous method mark. A candidate starting with $\dfrac{\cos\alpha}{\sin\alpha} - \sin\alpha = 2\sin\alpha - \dfrac{\cos\alpha}{\sin\alpha}$ scores M1dM1 straight away.

A1* Proceeds to given answer with no errors or omissions. The equation must start with an equation involving $\tan\alpha$ but see the note below for further guidance. Withold this mark for incorrect notation eg $\sin\alpha^2$ or if they had mixed variables on the same line. Eg α and θ.

Note: In the example below they can score full marks as $\tan\alpha = \dfrac{\sin\alpha}{\cos\alpha}$ is implied by their second term listed on the first line. Had they not written these first three terms or stated somewhere in their solution $\tan\alpha = \dfrac{\sin\alpha}{\cos\alpha}$ in their working then we would withhold the final mark.



$\tan\alpha = \dfrac{\sin\alpha}{\cos\alpha}$ implied here

(ii)(b)

M1 Attempts to use $\sin^2\alpha + \cos^2\alpha = 1$ Eg. $2\cos\alpha = 3\sin^2\alpha \Rightarrow 2\cos\alpha = 3(\pm 1 \pm \cos^2\alpha)$. Beware that a candidate may use this identity in part (ii)(a) which would not gain the mark in this part.

A1 $3\cos^2\alpha + 2\cos\alpha - 3 = 0$ The "=0" may be implied by later work but the terms must be collected on one side. Evidence of this may be awarded for correct coefficients substituted into the quadratic formula.

dM1 Attempts to solve their $3\cos^2\alpha + 2\cos\alpha - 3 = 0$ by the formula/completing the square, usual rules for solving a 3TQ apply but do not award for attempted factorisation unless their quadratic factorises.

Award for $(\cos\alpha =)$ $\dfrac{-1 \pm \sqrt{10}}{3}$ or $(\cos\alpha =)$ awrt 0.72 or awrt -1.4 or equivalent. You may need to check decimal values on your calculator.

A1 $(\cos\alpha =)$ $\dfrac{-2 + \sqrt{40}}{6}$ oe (typically $(\cos\alpha =)$ $\dfrac{-1 + \sqrt{10}}{3}$). Implied by $(\cos\alpha =)$ awrt 0.721or $(\alpha =)$ awrt 5.52 radians.

A1 $(\alpha =)$ awrt 5.517 radians and no others in the given range

Question Number	Scheme	Marks
10.(a)	$x=2, y=5 \Rightarrow 5=8a-12+6+b$	M1
	$\frac{dy}{dx}=3ax^2-6x+3$ **AND** $x=2, \frac{dy}{dx}=7 \Rightarrow 7=12a-12+3$	M1
	Solves $11=8a+b$ and $7=12a-9 \Rightarrow a=\frac{4}{3}, b=\frac{1}{3}$	A1 A1
		(4)
(b)	Sets $\frac{dy}{dx}=3ax^2-6x+3=0$ with their value of a and b	M1
	$4x^2-6x+3=0$ and attempts "b^2-4ac"	dM1
	$b^2-4ac=-12<0$ hence there are no turning points oe	A1*
		(3)
		(7 marks)

(a)

M1 Substitutes $x=2, y=5$ into $y=ax^3-3x^2+3x+b$ to get an equation in a and b (condone slips)

M1 Substitutes $x=2, \frac{dy}{dx}=7$ into $\frac{dy}{dx}=3ax^2-6x+3$ to get an equation in a ($\frac{dy}{dx}$ must be correct)

A1 $a=\frac{4}{3}$ or exact equivalent

A1 $b=\frac{1}{3}$ or exact equivalent

(b)

M1 Sets their $\frac{dy}{dx}=0$ with their value of a. This may be implied by later working.

dM1 Attempts to find b^2-4ac or roots via the formula

A1* Achieves $4x^2-6x+3=0,\ b^2-4ac=-12$ and states $-12<0$ and so there are ***no turning points*** or equivalent. They may attempt to solve the equation and either state that ***no real roots so no turning points*** or achieve complex roots and state that ***no real roots so no turning points***. Note full marks can be scored with an incorrect value for $b=\frac{1}{3}$ but cannot be scored from an incorrect value for $a=\frac{4}{3}$ from part (a)

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Alt (b)

M1 Attempts to complete the square for $\frac{dy}{dx}=3ax^2-6x+3$ for their value of a to achieve eg $4(x\pm...)^2$ or $(2x\pm...)^2$

dM1 $4x^2-6x+3=4\left(x\pm\frac{3}{4}\right)^2\pm...$ or $4x^2-6x+3=\left(2x\pm\frac{3}{2}\right)^2\pm...$

A1* Achieves $4x^2-6x+3=4\left(x-\frac{3}{4}\right)^2+\frac{3}{4}$ or $4x^2-6x+3=\left(2x-\frac{3}{2}\right)^2+\frac{3}{4}$ and states there are ***no turning points*** as $\frac{dy}{dx}>0$ (for all x) or equivalent.

If you see any other ways that may be credit worthy then send to review