Question Number	Scheme	Marks
9 (i)	States or uses $\tan x = \dfrac{\sin x}{\cos x}$	B1
	$\sin x \tan x = 5 \Rightarrow \sin^2 x = 5\cos x \Rightarrow 1-\cos^2 x = 5\cos x$	M1A1
	$\cos^2 x + 5\cos x - 1 = 0 \Rightarrow \left(\cos x =\right) \dfrac{-5 \pm \sqrt{29}}{2} \Rightarrow x =$ awrt $78.9°, 281.1°$	M1dM1A1
		(6)
(ii)	(a) $A = 5$	B1
		(1)
	(b) $2\theta - \dfrac{3\pi}{8} = \dfrac{3\pi}{2} \Rightarrow \theta = ...$	M1
	$\theta = \dfrac{15\pi}{16}$	A1
	y coordinate $Q = -3$ (or $2 - "A"$)	B1ft
		(3)
	(c) Sets $0 = "5"\sin\left(2\theta - \dfrac{3\pi}{8}\right) + 2 \Rightarrow \sin\left(2\theta - \dfrac{3\pi}{8}\right) = \pm\dfrac{2}{"5"}$	M1
	$\sin\left(2\theta - \dfrac{3\pi}{8}\right) = \pm\dfrac{2}{5} \Rightarrow \left(2\theta - \dfrac{3\pi}{8}\right) = \arcsin\left(\pm\dfrac{2}{5}\right) = ...$	dM1
	One of $\theta = 0.38,\ 2.4,\ 3.5,\ 5.5,\ 6.7,\ 8.6,\ 9.8....$	A1
	$\theta =$ awrt 5.51	A1
		(4)
		Total 14

(i) **Do not penalise working in another variable or if the variable is omitted at times in their working.**
e.g. sin instead of $\sin x$ is condoned as a slip or $\cos^2 x$ as $\cos x^2$.They are required to show the stages of working but not to the same level of accuracy in their presentation as a "show" or "prove" question.

B1: States or uses $\tan x = \dfrac{\sin x}{\cos x}$ (may be seen as $\sin x \tan x \Rightarrow \tan^2 x \cos x$)

M1: Uses $\pm\sin^2 x \pm \cos^2 x = \pm 1$ to set up a quadratic equation in cos *x* only. If terms have been collected on one side condone the omission of = 0. May form the equation $\tan^2 x \cos x = 5$ and use the identity $\pm 1 \pm \tan^2 x = \pm\sec^2 x$ proceeding to a quadratic in cos *x* only

$$\text{e.g.} \Rightarrow \cos x(\sec^2 - 1) = 5 \Rightarrow \frac{1}{\cos x} - \cos x = 5 \Rightarrow 1 - \cos^2 x = 5\cos x$$

or alternatively, square both sides and proceed to a quartic in cos *x* only.

A1: Correct 3TQ (or quartic) in cos *x*. The three terms do not need to be on the same side of the equation. The =0 may be implied by further work. e.g. attempting to solve the quadratic. Alternatively award for the quartic equation $\cos^4 x - 27\cos^2 x + 1 = 0$

M1: Attempts to solve their 3TQ (or quartic) in cos *x*. Usual rules apply for solving the quadratic. Accept via a calculator but at least one root must be correct (you may need to check this)
They cannot proceed from the 3TQ directly to an angle for *x*; this is M0 and no further marks can be scored.
Accept either root as a rounded decimal to 2sf e.g. for the correct quadratic it would be awrt 0.19 or awrt -5.2

dM1: Attempts to find one value for *x* in the given range using their root. You may need to check this. It is dependent on the previous method mark. Accept in radians. It is acceptable to proceed from the roots of their quadratic directly to an angle in the given range to score this mark. May be implied by awrt 79 or awrt 281 (or in radians awrt 1.4 or awrt 4.9)

A1: awrt $x = 78.9°, 281.1°$ (must be in degrees) and no others in the range.

(ii)(a)

B1: $A = 5$ Check by the question. If there are multiple answers, mark the answer in the main body of the work.

(ii)(b) **Solutions with no working:** Note if the two coordinates are given with no working then max M0A0B1 $\left(-3, \frac{15\pi}{16}\right)$ (or coordinates given the wrong way round) with no working seen then SC001

M1: Attempts to solve $2\theta - \frac{3\pi}{8} = \frac{3\pi}{2}$ or any other minimum value e.g. $2\theta - \frac{3\pi}{8} = -\frac{\pi}{2}$.

They must proceed using the correct order of operations e.g allow $\theta = \frac{\frac{3\pi}{2} \pm \frac{3\pi}{8}}{2}$, which may be implied by their answer. Answer only with no working though is M0A0.

If they have a mixture of radians and degrees within an equation and they do not "recover" then the method mark cannot be scored.

A1: $\left(\theta =\right) \frac{15\pi}{16}$ must be exact following a correct equation. May be seen as $\left(\frac{15\pi}{16}, -3\right)$ isw if they proceed to write the coordinates the wrong way round.

B1ft: *y* coordinate $Q = -3$ or follow through on $2 - "A"$ (may be seen on the diagram or by the question). If there is a contradiction, then the answer in the main body of the work takes precedence. If they proceed to write the coordinates the wrong way round then isw. May be seen as a pair of coordinates.

(ii)(c) **In EPEN this is M1A1dM1A1 but we are marking this M1dM1A1A1**
Solutions with no working in (c) scores 0 marks.

M1: Sets $0 = "5"\sin\left(2\theta - \frac{3\pi}{8}\right) + 2$ (which may be implied) and proceeds to $\sin\left(2\theta - \frac{3\pi}{8}\right) = \pm\frac{2}{"5"}$ o.e.

May be implied by e.g. $2\theta - \frac{3\pi}{8} = "-0.41..."$ or any other equivalent angle in radians or $2\theta - 67.5 = "-23.5..."$ or any other equivalent if working in degrees. You may need to check this. Allow use of *X* for 2θ or $2\theta - \frac{3\pi}{8}$

dM1: Proceeds from $\sin\left(2\theta - \frac{3\pi}{8}\right) = \pm\frac{2}{5}$ to $2\theta - \frac{3\pi}{8} = \arcsin\left(\pm\frac{2}{5}\right) = ...$ which is one of the values below:

$2\theta - \frac{3\pi}{8} = \arcsin\left(-\frac{2}{5}\right) = -0.41,\ 3.6,\ 5.9,\ 9.8,\ 12.2$ $\quad 2\theta - \frac{3\pi}{8} = \arcsin\left(\frac{2}{5}\right) = 0.41,\ 2.7,\ 6.7, 9.0,\ 13.0,\ 15.3$

May be implied by $2\theta = \arcsin\left(\pm\frac{2}{5}\right) + 1.17...$ or allow the expression $= \frac{\arcsin\left(\pm\frac{2}{5}\right) + \frac{3\pi}{8}}{2}$

The sign slip is only condoned before they take arcsin(…)

A1: Any one of the values in the table provided M1dM1 has been scored. Do not withhold this mark if other incorrect angles are seen.

	Radians (awrt)	Degrees (awrt)
θ	0.38, 2.4, 3.5, 5.5, 6.7, 8.6, 9.8, 11.8, 12.9	22, 136, 202, 316, 382, 496, 562, 676, 742

A1: $\theta =$ awrt 5.51 only (must be in radians). **(Can only be scored from correct working and all previous marks are scored)**

Question Number	Scheme	Marks
10 (a)	$\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right) x-2187x^{-\frac{5}{2}}$	M1, A1
	Sets $x-2187x^{-\frac{5}{2}}=0\Rightarrow x^{\frac{7}{2}}=2187$ $\left(\text{or e.g. } x=\left(\sqrt[7]{2187}\right)^2\right)\Rightarrow x=9$ *	dM1A1*
		(4)
(b)	e.g. $\int\left\{\frac{1}{2}x^2+1458x^{-\frac{3}{2}}-74\right\}\mathrm{d}x=\frac{1}{6}x^3-2916x^{-\frac{1}{2}}-74x$ or $\int\left\{\frac{1}{2}x^2+1458x^{-\frac{3}{2}}-"94.5"\right\}\mathrm{d}x=\frac{1}{6}x^3-2916x^{-\frac{1}{2}}-94.5x$	M1A1ft
	y value at P is 20.5	B1
	e.g. Area $R=\left[\frac{1}{6}x^3-2916x^{-\frac{1}{2}}-74x\right]_4^9-(9-4)\times"20.5"$ $=\left(\frac{1}{6}\times9^3-2916\times9^{-\frac{1}{2}}-74\times9\right)-\left(\frac{1}{6}\times4^3-2916\times4^{-\frac{1}{2}}-74\times4\right)-(9-4)\times"20.5"$	dM1
	$\left(-1516\frac{1}{2}+1743\frac{1}{3}-102\frac{1}{2}\right)=124\frac{1}{3}$	A1
		(5)
		Total 9

(a)

M1: Attempts to differentiate with one index correct e.g. $...x^2\rightarrow...x$ or $x^{-\frac{3}{2}}\rightarrow x^{-\frac{3}{2}-1}$ but not for $74\rightarrow0$.

A1: Correct differentiation. May be left unsimplified but indices must be processed.

dM1: Either solves their $\frac{\mathrm{d}y}{\mathrm{d}x}=0$ of the form $x-...x^m=0$ where *m* is a fraction via $x^n=A$ or $x=A^{\frac{1}{n}}$ It must be a solvable equation and they must correctly deal with the indices for their $\frac{\mathrm{d}y}{\mathrm{d}x}$. Look out for attempts where $\frac{\mathrm{d}y}{\mathrm{d}x}$ is manipulated before being set equal to zero which is acceptable.

e.g. $\frac{\mathrm{d}y}{\mathrm{d}x}=x^{\frac{7}{2}}-2187=0\Rightarrow x^{\frac{7}{2}}=2187\Rightarrow x=...$

Alternatively substitutes $x=9$ into their $\frac{\mathrm{d}y}{\mathrm{d}x}$ and finds its value.

A1*: Correct calculations and working leading to prove that the *x* coordinate of *P* is 9. It is sufficient to achieve $x^n=A$ and proceed directly to $x=9$ but e.g. $x-2187x^{-\frac{5}{2}}=0\Rightarrow x=9$ would be dM0A0.

It is also acceptable to proceed from $x-2187x^{-\frac{5}{2}}=0$ to an expression for *x* which is not the given answer before achieving $x=9$ e.g. $x=\left(\sqrt[7]{2187}\right)^2$

If using the verification method they should conclude that $x=9$ (or have a preamble that if $x=9$ is substituted in then $\frac{\mathrm{d}y}{\mathrm{d}x}=0$, then substitute in, achieves 0 followed by e.g. tick, QED etc.)