Question Number	Scheme	Marks
5(a) Way One	$\cot^2 x - \tan^2 x \equiv \dfrac{\cos^2 x}{\sin^2 x} - \dfrac{\sin^2 x}{\cos^2 x} \equiv \dfrac{\cos^4 x - \sin^4 x}{\sin^2 x \cos^2 x}$	M1
	$\equiv \dfrac{\left(\cos^2 x - \sin^2 x\right)\left(\cos^2 x + \sin^2 x\right)}{\sin^2 x \cos^2 x} \equiv \dfrac{\cos 2x}{\ldots}$ or $\dfrac{\ldots}{\left(\frac{1}{2}\sin 2x\right)^2}$	dM1
	$\equiv \dfrac{\cos 2x}{\left(\frac{1}{2}\sin 2x\right)^2}$	A1
	$\equiv 4\dfrac{\cos 2x}{\sin 2x \sin 2x} \equiv 4\cot 2x \operatorname{cosec} 2x$ *	A1*
		(4)
(b)	$4\cot 2\theta \operatorname{cosec} 2\theta = 2\tan^2\theta \Rightarrow \cot^2\theta - \tan^2\theta = 2\tan^2\theta \Rightarrow \cot^2\theta - 3\tan^2\theta = 0$	M1
	$\cot^2\theta - 3\tan^2\theta = 0 \Rightarrow \dfrac{1}{\tan^2\theta} - 3\tan^2\theta = 0 \Rightarrow \tan^4\theta = \dfrac{1}{3}$	A1
	$\tan^4\theta = "\frac{1}{3}" \Rightarrow \tan\theta = \pm\sqrt[4]{"\frac{1}{3}"} = "\pm 0.7598.." \Rightarrow \theta = \ldots$	M1
	$\theta =$ awrt $0.65,\ -0.65$	A1A1
		(5)
		Total 9

(a) Way One LHS to RHS

M1: Changes the LHS to sin *x* and cos *x* and attempts to make a single fraction using a correct common denominator. Condone errors/slips on the numerator

dM1: Attempts/ applies

- Either $\cos^4 x - \sin^4 x = \left(\cos^2 x - \sin^2 x\right)\left(\cos^2 x + \sin^2 x\right) = \cos^2 x - \sin^2 x = \cos 2x$ on the numerator
- Or $\sin 2x = 2\sin x \cos x$ to the denominator condoning bracketing slip

A1: Applies both of the above correctly to achieve a correct expression in terms of cos2*x* and sin2*x*

A1*: Reaches the right hand side with sufficient working shown. Expect to see $\sin^2 2x$ split into $\sin 2x \sin 2x$
Penalise consistent (not once or twice) use of poor notation on this mark only.

Examples $\cos^2 x \leftrightarrow \cos x^2$, $\sin^2 \leftrightarrow \sin^2 x$, constantly switching between $x \leftrightarrow \theta$

(b) Allow use of $x \leftrightarrow \theta$

M1: Uses part (a) and attempt to collects terms. (See Appendix III for ways not using part (a))
See below for equations in $\sin\theta$ or $\cos\theta$ where this mark is awarded for an equation in just $\sin\theta$ or $\cos\theta$

A1: Reaches a correct equation in a single term, usually $\tan\theta$. Look for $\tan^4\theta = \dfrac{1}{3}$ o.e. such as $3\tan^4\theta = 1$

Other correct intermediate forms are $2\sin^4\theta + 2\sin^2\theta - 1 = 0$ and $2\cos^4\theta - 6\cos^2\theta + 3 = 0$

M1: Takes the 4th root of their $\dfrac{1}{3}$ (o.e) and uses tan-1 (you may need to check) to obtain at least one value for θ

For the other intermediate forms look for working such as $\sin^2\theta = \dfrac{\sqrt{3}-1}{2} \Rightarrow \sin\theta = \sqrt{\dfrac{\sqrt{3}-1}{2}} \Rightarrow \theta = \ldots$

A1: Either awrt 0.65 or awrt –0.65. Allow either answer in degrees, so awrt $\pm 37.2°$
A1: Both answers in radians, awrt ± 0.65, and no extras in range
There are many different ways to do part (a). Generally, this is how they will be marked.
Most cases can be aligned to one of the three cases.

RHS to LHS

(a) Way 2	$4\cot 2x\,\text{cosec}2x \equiv 4\dfrac{\cos 2x}{\sin 2x}\times\dfrac{1}{\sin 2x} \equiv \dfrac{4\left(\cos^2 x-\sin^2 x\right)}{\ldots}$ or $\dfrac{\ldots}{4\sin^2 x\cos^2 x}$	M1
	$\dfrac{\cos^2 x-\sin^2 x}{\sin^2 x\cos^2 x} \equiv \dfrac{1}{\sin^2 x}-\dfrac{1}{\cos^2 x} \equiv \text{cosec}^2 x-\sec^2 x$	dM1A1
	$\equiv 1+\cot^2 x-1-\tan^2 x \equiv \cot^2 x-\tan^2 x$*	A1*

M1: Changes to sin 2*x* and cos 2*x* or tan2*x* and sin2*x* and attempts single angles in sin*x* and cos*x*
dM1: Changes to single angles throughout and splits into 2 separate fractions (which don't need to be simplified)
A1: Correct expression in terms of the single angles cosec x and sec x
A1*: Reaches the left hand side with sufficient working shown

Working on both sides: One possible way

(a) Way 3	$\cot^2 x-\tan^2 x \equiv 4\cot 2x\,\text{cosec}2x$ $\dfrac{\cos^2 x}{\sin^2 x}-\dfrac{\sin^2 x}{\cos^2 x} \equiv 4\times\dfrac{\cos 2x}{\sin 2x}\times\dfrac{1}{\sin 2x}$ $\cos^4 x-\sin^4 x \equiv 4\sin^2 x\cos^2 x\dfrac{\cos 2x}{\sin 2x}\times\dfrac{1}{\sin 2x}$	M1
	$\cos^4 x-\sin^4 x \equiv 4\times\sin^2 x\cos^2 x\dfrac{\left(\cos^2 x-\sin^2 x\right)}{\left(2\sin x\cos x\right)^2}$	dM1A1
	$\left(\cos^4 x-\sin^4 x\right) \equiv \left(\cos^2 x-\sin^2 x\right)$ $\left(\cos^2 x-\sin^2 x\right)\cancel{\left(\cos^2 x+\sin^2 x\right)} \equiv \left(\cos^2 x-\sin^2 x\right)$ Hence true 1	A1*

M1: Changes to sin *x*, cos *x*, sin 2*x* and cos2 *x* and attempts to cross multiply
dM1: Applies

- either $\cos^2 x - \sin^2 x = \cos 2x$ to the numerator
- or $\sin 2x = 2\sin x \cos x$ to the denominator

A1: Correct identity in terms of cos x and sin x
A1*: Reaches a point where both sides are equal and makes a minimal comment
Example of how you mark a "different" approach.

Question Number	Scheme	Marks
6(a)	(i) $P(0,\ 3a)$ (ii) $Q(a,\ 0)$ $R\left(\frac{7}{3}a,\ 0\right)$ (iii) $S\left(\frac{5}{3}a,\ -2a\right)$	B1 B1 B1 B1
		(4)
(b)	$3x-5a-2a=x-2a\Rightarrow x=...$ **or** $-(3x-5a)-2a=-(x-2a)\Rightarrow x=...$	M1
	$x=\frac{5}{2}a$ **or** $x=\frac{1}{2}a$	A1
	$3x-5a-2a=x-2a\Rightarrow x=...$ **and** $-(3x-5a)-2a=-(x-2a)\Rightarrow x=...$	dM1
	$x=\frac{5}{2}a$ **and** $x=\frac{1}{2}a$	A1
		(4)
		Total 8

(a) Question states simplest form so don't accept e.g. $\frac{10}{6}a$ for $\frac{5}{3}a$

(i)

B1: For (0, 3*a*). Condone just $y = 3a$ as long as there isn't a value for *x* coordinate (apart from 0).
Note that either of $P = 3a$ or (3*a*, 0) is B0 unless $y = 3a$ is previously seen

(ii)

B1: For either coordinate (*a*, 0) **or** $\left(\frac{7}{3}a,\ 0\right)$ which may or may not be linked correctly to *Q* and *R*

Condone just $x = a$ ($x = 1a$) or $x=\frac{7}{3}a$ as long as there isn't a *y* coordinate (that isn't 0).

Note that an answer such as $Q = a$ or (0, *a*) is B0 unless $x = a$ is previously seen.

Likewise an answer such as $R=\frac{7}{3}a$ or (0,7 *a*/ 3) is B0 unless $x = 7a/3$ is previously seen

B1: For (*a*, 0) **and** $\left(\frac{7}{3}a,\ 0\right)$. Allow the coordinates to be given separately. They do not need to be linked to the correct letter. Condone just $x = a$ ($x = 1a$) and $x=\frac{7}{3}a$ as long as there isn't a *y* coordinate(that isn't 0).

SC: $Q = a$ **AND** $R=\frac{7}{3}a$ or vice versa is B1 B0

(iii)

B1: $\left(\frac{5}{3}a,\ -2a\right)$. Allow this to be given as $x = ...$, $y = ...$