(b)(i)	$2\text{cosec}4\theta - \cot 2\theta = \sqrt{3} \Rightarrow \tan 2\theta = \sqrt{3} \Rightarrow \theta = ...$	M1
	$\Rightarrow \theta = \dfrac{\arctan\sqrt{3}}{2} = \dfrac{\pi}{6}$ or awrt 0.524	A1

M1: Uses part (a) to write the given equation in form $\tan 2\theta = \sqrt{3}$ and proceeds to a value for θ by finding arctan of $\sqrt{3}$ and dividing by 2.

It may be implied by e.g. $A = 2\theta \rightarrow \tan A = \sqrt{3} \Rightarrow A = ...$ as long as they then find a value for θ by finding arctan of $\sqrt{3}$ and dividing by 2.

If a candidate restarts then they must reach $\tan 2\theta = \sqrt{3}$

A1: Achieves $\theta = \dfrac{\pi}{6}$ or accept awrt 0.524 but not 30°

Ignore extra solutions outside the range but withhold this mark if there are extra solutions in range. Must follow the award of M1 so correct answer only scores no marks.

(ii)	$\tan\theta + \cot\theta = 5 \Rightarrow \sin 2\theta = \dfrac{2}{5}$	M1
	$\Rightarrow \theta = \dfrac{1}{2}\arcsin\left(\dfrac{2}{5}\right) =$ awrt 0.206,1.37	M1 A1
		(5)
		(9 marks)

M1: Uses part (a) to deduce that $\sin 2\theta = \dfrac{2}{5}$

M1: Uses the correct order of operations to find at least one angle for θ

It is for $\sin 2\theta = k$ where $|k| < 1$ followed by $\theta = \dfrac{1}{2}\arcsin(k) = ...$

If working is not shown you may need to check.

A1: For awrt 0.206 and awrt 1.37 and no other values in the range.

Accept awrt 0.0656π and awrt 0.436π.

Apply isw if values are subsequently rounded further.

Answers in degrees score A0 and correct answers with no working scores no marks.

Special cases:

$$\tan\theta + \cot\theta = 5 \Rightarrow \frac{\sin\theta}{\cos\theta} + \frac{\cos\theta}{\sin\theta} = 5 \Rightarrow \frac{1}{\frac{1}{2}\sin 2\theta} = 5 \Rightarrow \sin 2\theta = \frac{2}{5}$$

Scores M1 for reaching $\sin 2\theta = \dfrac{2}{5}$ as in the main scheme and then **d**M1A1 as above.

BUT

$$\tan\theta + \cot\theta = 5 \Rightarrow \tan\theta + \frac{1}{\tan\theta} = 5 \Rightarrow \tan^2\theta - 5\tan\theta + 1 = 0$$

$$\Rightarrow \tan\theta = \frac{5 \pm \sqrt{21}}{2} \Rightarrow \theta = \text{awrt } 0.206, 1.37$$

Scores M1 for reaching $\tan\theta = \dfrac{5 \pm \sqrt{21}}{2}$ and obtains awrt 0.206 **or** awrt 1.37

and then M1 for reaching $\tan\theta = \dfrac{5 \pm \sqrt{21}}{2}$ and obtains awrt 0.206 **and** awrt 1.37

The A1 is **not** available as they have not used part (a).

Question Number	Scheme	Marks
6(a)	$\text{fg}(1) = \text{f}(2) = 7$	M1A1
		(2)
(b)	Either $\text{g}(0) = 3$ or $\text{g}(x \to \infty) \to 0.5$	M1
	$0.5 < \text{g}(x)$,, 3	A1
		(2)
(c)	$y = \dfrac{x+9}{2x+3} \Rightarrow y(2x+3) = x+9$ $\Rightarrow x(2y-1) = 9-3y \Rightarrow x = \dfrac{9-3y}{2y-1}$	M1
	$\text{g}^{-1}(x) = \dfrac{9-3x}{2x-1}, \quad 0.5 < x \leq 3$	A1, B1ft
		(3)
(d)	Attempts to find $\text{f}(0) = 2\times3+5=11$ OR $\text{f}(3) = 5$	M1
	$5 < k \leq 11$	A1 A1
		(3)
		(10 marks)

Notes

(a)

M1: Full method for substituting their g(1) into f.

Can also be scored for seeing $x = 1$ substituted into $2\left|3-\dfrac{x+9}{2x+3}\right|+5$

A1: 7. Sight of 7 can achieve both marks if no incorrect work is seen.
Do not accept multiple answers.

(b)

M1: Achieves the correct value for either end of the range. Sight of 0.5 or 3 or e.g. $\dfrac{9}{3}$ is sufficient.

A1: Correct range and correct notation. Accept $0.5 < y \leq 3$ or e.g. $0.5 < \text{g} \leq 3$ or e.g. $(0.5, 3]$

(c)

M1: Full attempt to change the subject for $y = \dfrac{x+9}{2x+3}$ or $x = \dfrac{y+9}{2y+3}$

They must cross multiply and collect terms to get $x = \dfrac{ay+b}{cy+d}$ or $y = \dfrac{ax+b}{cx+d}$ oe where

a, b, c and d are non-zero.

A1: $\text{g}^{-1}(x) = \dfrac{9-3x}{2x-1}$. Accept y or g^{-1} for $\text{g}^{-1}(x)$

B1ft: Correct domain or follow through on their answer for (b) but it must be appropriate notation in terms of x.

E.g. $0.5 < x$,, 3 or $(0.5, 3]$

Do not follow through on $y \in \mathbb{R} \to x \in \mathbb{R}$

(d)

M1: Attempts f(0) or f(3).

Evidence could be seeing $2|3-0|+5$ or $2|3-3|+5$ or the sight of 5 or 11

It may be seen as one of the limits on k.

A1: Achieves correct limits of 5 and 11 which may be seen embedded e.g. $5 < k \leqslant 11$

A1: Fully correct $5 < k \leq 11$ oe e.g. $(5, 11]$