Question	Scheme	Marks
8(a)	$R = 17$	**B1**
	$\tan\alpha = \frac{15}{8}$	**M1**
	$\alpha = 1.081$	**A1**
		(3)
(b)	(i) Min f(x) $= \frac{15}{41 + 2\times"17"}$	**M1**
	$= \frac{1}{5}$	**A1**
	(ii) Occurs when $\sin(x - 1.081) = 1 \Rightarrow x - 1.081 = \frac{\pi}{2} \Rightarrow x = ...$	**M1**
	$x =$ awrt 2.65	**A1**
		(4)
(c)	$-\frac{23}{5}$ (or -4.6)	**B1ft**
		(1)
(d)	Awrt 1.33	**B1ft**
		(1)
		(9 marks)

Notes:

(a)

B1: For 17 only.

M1: Attempts an equation in α. Accept $\tan\alpha = \pm\frac{15}{8}$ or $\tan\alpha = \pm\frac{8}{15}$. If using R accept $\cos\alpha = \pm\frac{8}{"17"}$ or $\sin\alpha = \pm\frac{15}{"17"}$. Implied by a correct value for α

A1: Awrt 1.081. Must be in radians.

(b)(i)

M1: Attempts to apply the result from (a) to find the minimum. Allow for $\frac{15}{41 \pm 2\times"\text{their } R"}$

A1: cao.

(ii)

M1: Attempts to solve $x \pm "\alpha" = \frac{\pi}{2}$

A1: cao

(c)

B1ft: Correct answer or follow through $2\times\left("\text{their}"\frac{1}{5}\right) - 5$ and no other solutions.

(d)

B1ft: For awrt 1.33 or follow through $0.5\times\text{their } 2.65$ and no other solutions.

Question	Scheme	Marks
9(a)	$\dfrac{\cos^2\theta}{\cos 2\theta-\sin 3\theta}=\dfrac{\cos^2\theta}{\cos 2\theta-(\sin 2\theta\cos\theta+\cos 2\theta\sin\theta)}$	**M1**
	$=\dfrac{\cos^2\theta}{1-2\sin^2\theta-2\sin\theta\cos^2\theta-\sin\theta(1-2\sin^2\theta)}$	**M1**
	$=\dfrac{1-\sin^2\theta}{1-3\sin\theta-2\sin^2\theta+4\sin^3\theta}=\dfrac{(1-\sin\theta)(1+\sin\theta)}{(1-\sin\theta)(1-2\sin\theta-4\sin^2\theta)}$	**M1**
	$=\dfrac{1+\sin\theta}{1-2\sin\theta-4\sin^2\theta}$ *	**A1***
		(4)
(b)	$\dfrac{1+\sin\theta}{1-2\sin\theta-4\sin^2\theta}=2\text{cosec}\,\theta\Rightarrow(1+\sin\theta)\sin\theta=2(1-2\sin\theta-4\sin^2\theta)$	**M1**
	$\Rightarrow 9\sin^2\theta+5\sin\theta-2=0$	**A1**
	$\Rightarrow\sin\theta=\dfrac{-5\pm\sqrt{25-4\times9\times-2}}{18}=\ldots\Rightarrow\theta=\sin^{-1}\ldots$	**M1**
	Two of $\theta=15.6°,164.4°,235.6°,304.4°$	**A1**
	All of $\theta=15.6°,164.4°,235.6°,304.4°$	**A1**
		(5)
		(9 marks)

Notes:

(a)

M1: Applies the compound angle formula to $\sin 3\theta$. Accept $\pm\sin\theta\cos 2\theta\pm\sin 2\theta\cos\theta$ Allow for students who apply $\sin 3\theta=3\sin\theta-4\sin^3\theta$ directly. May be seen anywhere (e.g. in separate working).

M1: Uses correct double angle formula for cos2θ **and** sin2θ (or assumed used correctly if correct sin3θ formula was used) to achieve all terms in single angle. (May be scored after the third M.)

M1: Uses Pythagorean identity to identify the factor of $1-\sin\theta$ in numerator. They need not have achieved single angle arguments for all terms for this mark. (May be scored before the second M.) There must be an intermediate step before the given answer with $1-\sin\theta$ cancelled if the factor is not explicitly seen in the numerator.

A1: Cancels the $1-\sin\theta$ from numerator and denominator and simplifies to the given result with no incorrect steps or consistently incorrect notation.

(b)

M1: Substitutes the result from (a) and cross multiplies to get an equation in sin θ only.

A1: Correct simplified quadratic in sin θ

M1: Solves the resulting quadratic by formula, completing square or calculator (allow by factorisation if their quadratic factorises) and applies inverse sine to at least one root. May be implied by any correct arcsin of one of their solutions, such as −55.6°. My be implied by a radians answer (e.g. 0.272, 2.869…)

A1: Any two correct solutions in the range, accept awrt. Answers in radians scores A0.

A1: Awrt all four solutions correct and no others in the range.

9(a)	$\dfrac{\cos^2\theta}{\cos 2\theta-\sin 3\theta}=\dfrac{\cos^2\theta}{\cos 2\theta-(\sin 2\theta\cos\theta+\cos 2\theta\sin\theta)}$	**M1**