Question Number	Scheme	Notes	Marks
7(i)	$3\sin(2x-15°)=\cos(2x-15°)$ $\Rightarrow \tan(2x-15°)=\frac{1}{3}$	Uses $\tan\theta\equiv\frac{\sin\theta}{\cos\theta}$ and reaches $\tan(2x-15°)=...$	M1
	$\Rightarrow x=\frac{\tan^{-1}\left(\frac{1}{3}\right)\pm 15°}{2}$	Correct strategy for finding *x*	M1
	$x=16.7°,\ -73.3°$	One of awrt 16.7 **or** –73.3	A1
		Awrt 16.7 **and** awrt –73.3 and no extras in range	A1
			(4)
(ii)	$4\sin^2\theta+8\cos\theta=3$ $\Rightarrow 4(1-\cos^2\theta)+8\cos\theta=3$ $\Rightarrow 4\cos^2\theta-8\cos\theta-1=0$	Applies $\sin^2\theta=1-\cos^2\theta$ and collects terms to obtain a 3TQ in cos θ	M1
	$\cos\theta=\frac{8\pm\sqrt{64+4\times4}}{2\times4}\Rightarrow\theta=\cos^{-1}\left(1-\frac{\sqrt{5}}{2}\right)=...$	Solves their 3TQ and takes inverse cos to obtain at least one value for θ	M1
	$\theta=1.69,\ 4.59$	Awrt 1.69 **or** 4.59	A1
		Awrt 1.69 **and** awrt 4.59 and no extras in range	A1
			(4)
			Total 8

Notes (i)

M1: Evidence of correct identity $\tan\theta=\frac{\sin\theta}{\cos\theta}$ seen, with attempt made to reach an equation $\tan(2x-15°)=k$. Note $\tan(2x-15°)=3$ with no correct identity stated is M0, but if correct identity stated first allow M1 as a slip. Allow recovery for all relevant marks for $3\tan(2x-15°)=0\rightarrow\tan(2x-15°)=\frac{1}{3}$ but allow only the first M if $\tan(2x-15°)=0$ follows.

Allow with e.g. $\tan y=...$ as long as *y* has been clearly defined as 2*x* − 15°.

Alternatively, may square both sides (including the 3) and apply $\sin^2\theta+\cos^2\theta=1$ to reach an equation in sin or cos. They should get $\sin(2x-15°)=\pm\frac{1}{\sqrt{10}}$ or $\cos(2x-15°)=\pm\frac{3}{\sqrt{10}}$ if correct but allow the method if slips in rearranging are made.

M1: Correct order of operations from $\tan(2x-15°)=k$ (any non-zero *k*) to produce a value of *x,* so applies arctan, then attempts to move the 15° across before dividing by 2. Must be working in degrees OR entirely in radians (if the 15° is converted first).

A1: One of awrt 16.7 **or** –73.3. Must have come from a correct equation – answer from calculators score A0 (they will not have score the M).

A1: Both of awrt 16.7 **and** –73.3 and no other solutions in the range. Must have come from a correct equation – answer from calculators score A0 (they will not have scored the M).

(ii)

M1: Applies $\sin^2\theta=1-\cos^2\theta$ and collects terms to obtain a 3TQ in cos θ or rearranges suitably to be able to solve via completing the square (oe method). Allow the method marks if there are notation errors (e.g. missing θ.

M1: Solves their 3TQ and takes inverse cos to obtain at least one value for θ (may be implied by answers to 1d.p.). Usual rules for solving. Answers in degrees can score this method mark for find one angle.

A1: One correct answer, awrt 1.69 or awrt 4.59. Must be in radians.

A1: Both correct, awrt 1.69 and awrt 4.59, and no other solutions in the range.

Question Number	Scheme	Notes	Marks
8(a)	$u_{20} = 100 + 19(-2) = 62$*	Correct method shown	B1*
			(1)
(b)	$S_{20} = \frac{1}{2}(20)\{2\times 100 + 19(-2)\} = \ldots$ **or** $S_{20} = \frac{1}{2}(20)\{100 + 62\} = \ldots$	Applies a correct AP sum formula with $n = 20$, $a = 100$ and $d = -2$ **or** $n = 20$, $a = 100$ and $l = 62$	M1
	$= 1620$ (mm)	Correct value	A1
			(2)
(c)	$62 \times r^2 = 60 \Rightarrow r^2 = \ldots$	Correct strategy to find r	M1
	$r^2 = \frac{60}{62} \Rightarrow r = \sqrt{\frac{60}{62}}$ = 0.983738...	r = awrt 0.984	A1
			(2)
(d)	Total distance from GS hits = $\frac{62 \times 0.983\ldots(1 - 0.983\ldots^n)}{1 - 0.983\ldots}$		M1
	$1620 + \frac{62 \times 0.983\ldots(1 - 0.983\ldots^n)}{1 - 0.983\ldots} > 3000$	Correct equation set up with their r and suitable a	M1
	$0.983\ldots^n < 0.63207\ldots \Rightarrow n = \frac{\log(0.63207\ldots)}{\log(0.983\ldots)}$	Fully correct processing to find n from an equation of suitable form,	M1
	$n = 27.98\ldots \Rightarrow N = 20 + 28 = 48$	N = 48 only	A1cso
			(4)
	(d) Alternative taking 20th hit as first term of GP		
	Total distance from GS hits = $\frac{62(1 - 0.983\ldots^n)}{1 - 0.983\ldots}$		M1
	$1620 - 62 + \frac{62(1 - 0.983\ldots^n)}{1 - 0.983\ldots} > 3000$	Correct equation set up with their r and suitable a	M1
	$0.983\ldots^n < 0.62179\ldots \Rightarrow n = \frac{\log(0.62179\ldots)}{\log(0.983\ldots)}$	Fully correct processing to find n from an equation of suitable form,	M1
	$n = 28.98\ldots \Rightarrow N = 19 + 29 = 48$	N = 48 only	A1cso
			Total 9

Notes

(a)

B1*: Correct method shown, identifies the common difference and attempts the 20th term. Accept as minimum seeing $100 + 19(-2) = 62$.

Alternatively, allow for setting up an equation $62 = 100 + (n-1)(-2)$ and solving to find n = 20

If listing, there must be the correct 20 terms with final term 62.

(b)

M1: Applies a correct AP sum formula with n = 20, a = 100 and d = –2 or with n = 20, a =100 and l = 62. Alternatively, by listing look for 20 terms listed with attempt to sum, or implied by answer.

A1: Correct value, units not needed.

(c)