Question	Scheme	Marks
2(i)	$1+\sin^2 x+\cos x=0 \Rightarrow 1+1-\cos^2 x+\cos x=0$	B1
	$\Rightarrow \cos^2 x-\cos x-2=0 \Rightarrow (\cos x-2)(\cos x+1)=0 \Rightarrow \cos x=...$	M1
	$\Rightarrow \cos x=-1 \Rightarrow x=\pi$	A1
		(3)
(ii)	$\sin(\theta+60^o)=4\cos(\theta+60^o) \Rightarrow \tan(\theta+60^o)=4$	B1
	$\Rightarrow \theta=\arctan('4')-60^\circ$	M1
	$=16.0^\circ$	A1
		(3)
		(6 marks)

(i) Condone omission of the variable *x* at any point in the solution

B1: Correct application of $\sin^2 x=1-\cos^2 x$ to the equation. E.g. sight of $1+1-\cos^2 x+\cos x=0$

M1: Forms and solves a 3-term quadratic in cos *x*

- allow this mark to be awarded if sign errors are made e.g. $\sin^2 x=\pm 1\pm\cos^2 x$
- allow a solution of a 3TQ in cos *x* via any means including via a calculator leading to $\cos x=...$ If a calculator is used the roots (values of cos*x*) must be correct for their quadratic
- do NOT allow a solution without the intermediate step. E.g. $\cos^2 x-\cos x-2=0 \Rightarrow \pi(\text{or } 180°)$

A1: Correct answer only. It must be exact and **must** follow B1, M1

If they correctly find $x=\pi$ and then follow this with 3.14 then allow. An answer of 180° is A0

Do not accept any other answers within the range $0<x\leqslant 2\pi$

(ii) Condone omission of degrees symbol at any point in the solution. Missing brackets can only be condoned if their subsequent work implies their intended presence.

B1: Correct application of ' $\tan(\theta+60^\circ)=\sin(\theta+60^\circ)/\cos(\theta+60^\circ)$' to reach $\tan(\theta+60^\circ)=4$

You may see $x=\theta+60°$ in which case it would be for $\tan x=4$

M1: Correct process from $\tan(\theta+60^\circ)=k,\quad k\neq 0$ to reach a value for θ, allow $\theta=\arctan(k)\pm 60^\circ$

So $\tan(\theta+60^\circ)=\frac{1}{4} \Rightarrow \theta+60^\circ=14° \Rightarrow \theta^\circ=-46°$ or indeed 74° would score M1

Note that $\tan(\theta+60^\circ)=4 \Rightarrow \theta+60^\circ=1.326 \Rightarrow \theta^\circ=...$ would score M0 due to mixed units

It is possible to use $\dfrac{\tan\theta+\tan 60}{1-\tan\theta\tan 60}=k\Rightarrow\tan\theta=p\Rightarrow\theta=\arctan p$

A1: Correct answer only. Accept awrt 16.0 but not 15.9 or 16 unless you previously see an allowable answer. It **must** follow B1, M1.

Condone extra solutions **only if** they are outside the range

Longer methods via squaring may be seen in (ii)

E.g. I

B1: Applies tan $\theta=\sin\theta/\cos\theta$ correctly in their solution to reach $\tan\theta=\dfrac{4-\sqrt{3}}{1+4\sqrt{3}}$

M1: Attempts both compound angle formulae, rearranges to tan θ = … and applies arctan

$$\frac{1}{2}\sin\theta+\frac{\sqrt{3}}{2}\cos\theta=4\left(\frac{1}{2}\cos\theta-\frac{\sqrt{3}}{2}\sin\theta\right)\Rightarrow\tan\theta=\tan\theta=\frac{4-\sqrt{3}}{1+4\sqrt{3}}\Rightarrow\theta=\tan^{-1}(...)=...$$

Condone sign slips in their compound angle identities and processing errors as allowed in the main method

A1: Correct answer following B1, M1

E.g. II

$$\sin^2\left(\theta+60^o\right)=16\cos^2\left(\theta+60^o\right)\Rightarrow\sin^2\left(\theta+60^o\right)=\frac{16}{17}\text{ or }\Rightarrow\cos^2\left(\theta+60^o\right)=\frac{1}{17}$$

B1: Correct equation. Either $\sin^2\left(\theta+60^o\right)=\dfrac{16}{17}$ or $\cos^2\left(\theta+60^o\right)=\dfrac{1}{17}$

M1: Correct process from, for example, $\sin^2\left(\theta+60^o\right)=p\qquad 0<p<1$

$$\sin^2\left(\theta+60^o\right)=p\Rightarrow\sin\left(\theta+60^o\right)=\sqrt{p}\Rightarrow\theta=\arcsin\left(\sqrt{p}\right)\pm 60^o$$

A1: Correct answer following B1, M1

Question	Scheme	Marks
3(a) (i)	$d = u_2 - u_1 = -6 - 3 = -9$	**M1**
	Also, $u_4 - u_2 = -24 - (-6) = -18 = 2 \times -9$ Difference is consistent so could be arithmetic	**A1**
	$u_3 = -15$	**B1**
(ii)	$r = \dfrac{u_2}{u_1} = \dfrac{-6}{3} = -2$	**M1**
	Also, $\dfrac{u_4}{u_2} = \dfrac{-24}{-6} = 4 = (-2)^2$ Ratio is consistent so could be geometric	**A1**
	$u_3 = 12$	**B1**
		(6)
(b)	$u_1 = u_5 = u_9 = u_{13}$ etc $\Rightarrow \sum_{i=1}^{50} u_i = 12 \times (3 - 6 + u_3 - 24) + 3 - 6$	**M1**
	$\Rightarrow 12(u_3 - 27) - 3 = 141 \Rightarrow u_3 = ...$	**dM1**
	$u_3 = 39$	**A1**
		(3)
		(9 marks)

(a)(i)

M1: Attempts to find the common difference of the first two terms.

Implied by sight of ± 9 or $(-6)-(3)$ either way around

A1: Must be using a correct common difference of -9.

It requires a correct reason and minimal conclusion.

Acceptable reasons must include the first, second and fourth terms.

Examples of allowable reasons and conclusions are;

- if arithmetic $d = -9,\ u_4 = a + 3d = 3 + 3 \times -9 = -24$ ✓ (Calculation seen)
- $3,\ -6,\ -15,\ -24$ terms **all** decrease by 9 so (could be) arithmetic (explained in words)

B1: $u_3 = -15$

A minimal possible solution scoring 3 marks is;

$3,\ -6,\ u_3,\ -24$ (with -9, -9, -9) scores M1,

followed by $u_3 = -15$ scores B1 (which may be seen in the list), followed by appropriate wording

'Differences are constant, so (could be) arithmetic' which scores the A1

Or 'Common difference (in words, not just $d =$) is -9, so ✓ , which scores A1'