Question	Scheme	Marks	AOs
7 (a)	Sets $50 = 7\times 14\sin(SPQ)$ oe	B1	1.2
	Finds $180° - \arcsin\left("\frac{50}{98}"\right)$	M1	1.1b
	$= 149.32°$	A1	1.1b
		(3)	
(b)	Method of finding SQ $SQ^2 = 14^2 + 7^2 - 2\times 14\times 7\cos"149.32"$	M1	1.1b
	= 20.3 cm	A1	1.1b
		(2)	
			(5 marks)
Alt(a)	States or uses $14h = 50$ or $7h_1 = 50$	B1	1.2
	Full method to find obtuse $\angle SPQ$. In this case it is $90° + \arccos\left(\frac{h}{7}\right)$ or $90° + \arccos\left(\frac{h_1}{14}\right)$	M1	1.1b
	awrt $149.32°$	A1	1.1b

Notes

(a)

B1: Sets $50 = 7\times 14\sin(SPQ)$ oe

M1: Attempts the correct method of finding obtuse $\angle SPQ$. See scheme.

A1: awrt $149.32°$

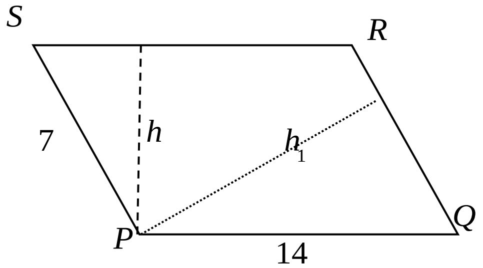
(b)

M1: A correct method of finding SQ using their $\angle SPQ$.

$SQ^2 = 14^2 + 7^2 - 2\times 14\times 7\cos"149.32"$ scores this mark.

A1: awrt 20.3 cm (condone lack of units)

Alt(a)



B1: States or uses $14h = 50$ or $7h_1 = 50$

M1: Full method to find obtuse $\angle SPQ$.

In this case it is $90° + \arccos\left(\frac{h}{7}\right)$ or $90° + \arccos\left(\frac{h_1}{14}\right)$

A1: awrt $149.32°$

Question	Scheme	Marks	AOs
7 (a)	Uses $15=\frac{1}{2}\times5\times10\times\sin\theta$	M1	1.1b
	$\sin\theta=\frac{3}{5}$ oe	A1	1.1b
	Uses $\cos^2\theta=1-\sin^2\theta$	M1	2.1
	$\cos\theta=\pm\frac{4}{5}$	A1	1.1b
		(4)	
(b)	Uses $BC^2=10^2+5^2-2\times10\times5\times"-\frac{4}{5}"$	M1	3.1a
	$BC=\sqrt{205}$	A1	1.1b
		(2)	
		(6 marks)	

Notes

(a)

M1: Uses the formula $\text{Area}=\frac{1}{2}ab\sin C$ in an attempt to find the value of $\sin\theta$ or θ

A1: $\sin\theta=\frac{3}{5}$ oe This may be implied by $\theta=$ awrt 36.9° or awrt 0.644 (radians)

M1: Uses their value of $\sin\theta$ to find two values of $\cos\theta$ This may be scored via the formula $\cos^2\theta=1-\sin^2\theta$ or by a triangle method. Also allow the use of a graphical calculator or candidates may just write down the **two values**. The values must be symmetrical $\pm k$

A1: $\cos\theta=\pm\frac{4}{5}$ or ±0.8 Condone these values appearing from $\pm0.79....$

(b)

M1: Uses a suitable method of finding the longest side. For example chooses the negative value (or the obtuse angle) and proceeds to find *BC* using the cosine rule. Alternatively works out *BC* using both values and chooses the larger value. If stated the cosine rule should be correct (with a minus sign). Note if the sign is +ve and the acute angle is chosen the correct value will be seen. It is however M0 A0

A1: $BC=\sqrt{205}$

Question	Scheme	Marks	AOs
6 (a)	Uses $18\sqrt{3}=\frac{1}{2}\times 2x\times 3x\times \sin 60°$	M1	1.1a
	Sight of $\sin 60°=\frac{\sqrt{3}}{2}$ and proceeds to $x^2=k$ oe	M1	1.1b
	$x=\sqrt{12}=2\sqrt{3}$ *	A1*	2.1
		(3)	
(b)	Uses $BC^2=\left(6\sqrt{3}\right)^2+\left(4\sqrt{3}\right)^2-2\times 6\sqrt{3}\times 4\sqrt{3}\times \cos 60°$	M1	1.1b
	$BC^2=84$	A1	1.1b
	$BC=2\sqrt{21}$ (cm)	A1	1.1b
		(3)	
			(6 marks)

Notes

(a)

M1: Attempts to use the formula $A=\frac{1}{2}ab\sin C$.

If the candidate writes $18\sqrt{3}=\frac{1}{2}\times 5x\times \sin 60°$ **without** sight of a previous correct line then this would be M0

M1: Sight of $\sin 60°=\frac{\sqrt{3}}{2}$ or awrt 0.866 and proceeds to $x^2=k$ oe such as $px^2=q$

This may be awarded from the correct formula or $A=ab\sin C$

A1*: Look for $x^2=12\Rightarrow x=2\sqrt{3}$, $x^2=4\times 3\Rightarrow x=2\sqrt{3}$ or $x=\sqrt{12}=2\sqrt{3}$

This is a given answer and all aspects must be correct including one of the above intermediate lines. It cannot be scored by using decimal equivalents to $\sqrt{3}$

Alternative using the given answer of $x=2\sqrt{3}$

M1: Attempts to use the formula $A=\frac{1}{2}\times 4\sqrt{3}\times 6\sqrt{3}\sin 60°$ oe

M1: Sight of $\sin 60°=\frac{\sqrt{3}}{2}$ and proceeds to $A=18\sqrt{3}$

A1*: Concludes that $x=2\sqrt{3}$

(b)

M1: Attempts the cosine rule with the sides in the correct position.

This can be scored from $BC^2=(3x)^2+(2x)^2-2\times 3x\times 2x\times \cos 60°$ as long as there is some attempt to substitute x in later. Condone slips on the squaring

A1: $BC^2=84$ Accept $BC^2=7\times 12$, $BC=\sqrt{84}$ or $BC=2\sqrt{21}$

If they replace the surds with decimals they can score the A1 for $BC^2=$ awrt 84.0

A1: $BC=2\sqrt{21}$

Condone other variables, say $x=2\sqrt{21}$, but it cannot be scored via decimals.

Question	Scheme	Marks	AOs
5 (a)	States $\frac{\sin\theta}{12}=\frac{\sin 27}{7}$	M1	1.1b
	Finds $\theta =$ awrt $51°$ or awrt $129°$	A1	1.1b
	$=$ awrt $128.9°$	A1	1.1b
		(3)	
(b)	Attempts to find part or all of AD Eg $AD^2=7^2+12^2-2\times12\times7\cos101.9=(AD=15.09)$ Eg $(AC)^2=7^2+12^2-2\times12\times7\cos\left(180-\text{"}128.9\text{"}-27\right)$ Eg $12\cos27$ or $7\cos\text{"}51\text{"}$	M1	1.1b
	Full method for the total length = $12+7+7+\text{"}15.09\text{"}=$	dM1	3.1a
	$= 42$ m	A1	3.2a
		(3)	
			(6 marks)

Notes

(a)

M1: States $\frac{\sin\theta}{12}=\frac{\sin 27}{7}$ oe with the sides and angles in the correct positions

Alternatively they may use the cosine rule on $\angle ACB$ and then solve the subsequent quadratic to find AC and then use the cosine rule again

A1: awrt $51°$ or awrt $129°$

A1: Awrt $128.9°$ only (must be seen in part a))

(b)

M1: Attempts a "correct" method of finding either AD or a part of AD eg (AC or CD or forming a perpendicular to split the triangle into two right angled triangles to find AX or XD) which may be seen in (a).
You should condone incorrect labelling of the side.
Look for attempted application of the cosine rule

$$(AD)^2=7^2+12^2-2\times12\times7\cos\left(\text{"}128.9\text{"}-27\right)$$

$$\text{or } (AC)^2=7^2+12^2-2\times12\times7\cos\left(180-\text{"}128.9\text{"}-27\right)$$

Or an attempted application of the sine rule $\frac{(AD)}{\sin\left(\text{"}128.9\text{"}-27\right)}=\frac{7}{\sin 27}$

$$\text{Or } \frac{(AC)}{\sin\left(180-\text{"}128.9\text{"}-27\right)}=\frac{7}{\sin 27}$$

Question	Scheme		Marks	AOs
8(a)	**Way 1** Finds third angle of triangle and uses or states $\frac{x}{\sin 60°} = \frac{30}{\sin "50°"}$	**Way 2** Finds third angle of triangle and uses or states $\frac{y}{\sin 70°} = \frac{30}{\sin "50°"}$	M1	2.1
	So $x = \frac{30 \sin 60°}{\sin 50°}$ $(= 33.9)$	So $y = \frac{30 \sin 70°}{\sin 50°}$ $(= 36.8)$	A1	1.1b
	Area = $\frac{1}{2} \times 30 \times x \times \sin 70°$ or $\frac{1}{2} \times 30 \times y \times \sin 60$		M1	3.1a
	$= 478 \text{ m}^2$		A1ft	1.1b
			(4)	
(b)	Plausible reason e.g. Because the angles and the side length are not given to four significant figures Or e.g. The lawn may not be flat		B1	3.2b
			(1)	
				(5 marks)

Notes:

(a)

M1: Uses sine rule with their third angle to find one of the unknown side lengths

A1: Finds expression for, or value of either side length

M1: Completes method to find area of triangle

A1ft: Obtains a correct answer for their value of x or their value of y

(b)

B1: As information given in the question may not be accurate to 4sf or the lawn may not be flat so modelling by a plane figure may not be accurate

Question Number	Scheme	Marks
2.	$\frac{\sin x}{16} = \frac{\sin 50^0}{13}$	M1
	$(\sin x) = \frac{16 \times \sin 50}{13}$ $(= 0.943 \text{ but accept } 0.94)$	A1
	x = awrt 70.5(3) **and** 109.5 **or** 70.6 and 109.4	dM1 A1 **(4)** **[4]**

	Notes
	Notes M1: use sine formula correctly **in any form.** Allow awrt 0.77 for $\sin 50°$ A1: give the correct value or correct expression for $\sin x$ (this implies the M1 mark). If it is given as expression they do not need degrees symbol. $\frac{\sin 50 \times 16}{13}$ is fine, If this is given as a decimal allow answers which round to 0.94. Allow awrt −0.323 (radians) here but no further marks are available. If they give this as x (not sin$x$) and do not recover this is A0 dM1: Correct work leading to x=… (via inverse sin) expression or value for sin$x$ If the previous A mark has been awarded for a correct expression then this is for getting to awrt 70.5 or 109.5 (allow for 70.6 or 109.4). If the previous A mark was not gained, e.g. rounding errors were made in rearranging the correct sine formula then award dM1 for evidence of use of **inverse sin in degrees** on their value for sin$x$ (may need to check on calculator). **NB** 70.5 following a correct sine formula will gain M1A1M1. A1: deduce and state **both of the answers** x = 70.5 and 109.5 (do not need degrees) Accept awrt these. Also accept 70.6 and 109.4. (Second answer is sometimes obtained by a long indirect route but still scores A1) If working in radians throughout, answers are 1.23 and 1.91 and this can be awarded M1 A1 M1 A0 (Working with 50 radians gives probable answers of -0.3288 and 3.47 giving M1A1M0A0) **Special case:** Wrong labelling of triangle. This simplifies the problem as there is only one solution for angle x. So it is not treated as a misread. If they find the missing side as awrt 12.6 then proceed to find an angle or its sine or cosine then give M1A0M0A0
	Alternative Method using cosine rule Let $BC = a$. M1: uses the cosine rule to form to form a three term quadratic equation in a (e.g. $a^2 - 32a\cos 50^\circ + 87 = 0$ or $a^2 - \text{awrt}20.6a + 87 = 0$ though allow slips in signs rearranging) A1: Solves and obtains a correct value for a of awrt 14.6 **or** awrt 5.95. dM1: A **correct full** method to find (at least) one of the two angles. May use cosine rule again, or find angle BAC and then use sine rule. As in the main scheme, if the previous A mark has been awarded then they should obtain one of the correct angles for this mark. A1: deduces both correct answer as in main scheme. **NB** obtaining only one correct angle will usually score M1A1M1A0 in any method.

Question Number	Scheme	Marks
4.(a)	Attempts Area $=\frac{1}{2}ab\sin C \Rightarrow 24\sqrt{3}=\frac{1}{2}3x\times x\sin 60°$	M1
	Uses $\sin 60° = \frac{\sqrt{3}}{2}$ oe $\Rightarrow x^2 = 32 \Rightarrow x = 4\sqrt{2}$	dM1A1*
		[3]
(b)	Uses $BC^2 = \left(12\sqrt{2}\right)^2 + \left(4\sqrt{2}\right)^2 - 2\left(12\sqrt{2}\right)\left(4\sqrt{2}\right)\cos 60°$	M1
	$\Rightarrow BC^2 = 224 \Rightarrow BC = 4\sqrt{14}$	A1,A1
		[3] **(6 marks)**

(a)

M1 Attempts to use Area $=\frac{1}{2}ab\sin C$ Score for sight of $24\sqrt{3}=\frac{1}{2}3x\times x\sin 60°$

dM1 Either using $24\sqrt{3}=\frac{1}{2}3x\times x\sin 60°$ with $\sin 60° = \frac{\sqrt{3}}{2}$(which may be implied) to reach a form $x^2 = k$

So sight of $x^2 = \frac{16\sqrt{3}}{\sin 60°}$ oe $\Rightarrow x = 4\sqrt{2}$ would imply $\sin 60° = \frac{\sqrt{3}}{2}$ and $x^2 = k$

Or sight of a correct simplified intermediate line followed by the correct answer.

Eg. $24\sqrt{3}=\frac{1}{2}3x\times x\sin 60° \Rightarrow 3x^2 = 96 \Rightarrow x = 4\sqrt{2}$

It cannot be awarded for $24\sqrt{3}=\frac{1}{2}3x\times x\times\frac{\sqrt{3}}{2} \Rightarrow x = 4\sqrt{2}$

A1* This is a show that and you must see $x = 4\sqrt{2}$ following $x^2 = 32$ OR $x^2 = 16\times 2$ or $x=\sqrt{32}$ for the A1* to be scored

If you see a candidate start $41.57 = \frac{1}{2}3x\times x\times 0.866 \Rightarrow x^2 = 32 \Rightarrow x = 4\sqrt{2}$ award M1, dM1, A0

Alternatively candidate can assume that $x = 4\sqrt{2}$ and attempt $\frac{1}{2}4\sqrt{2}\times 12\sqrt{2}\sin 60°$ for M1, $\frac{1}{2}4\sqrt{2}\times 12\sqrt{2}\times\frac{\sqrt{3}}{2} = 24\sqrt{2}$ for dM1 and make a statement for A1*

(b)

M1 Uses the cosine rule $BC^2 = \left(4\sqrt{2}\right)^2 + \left(12\sqrt{2}\right)^2 - 2\left(4\sqrt{2}\right)\left(12\sqrt{2}\right)\cos 60°$ Condone missing brackets

Can be scored for $BC^2 = (3x)^2 + (x)^2 - 2(3x)(x)\cos 60°$ It can be awarded for an attempt with their x

Also accept the form $\cos 60° = \frac{\left(12\sqrt{2}\right)^2 + \left(4\sqrt{2}\right)^2 - BC^2}{2\left(12\sqrt{2}\right)\left(4\sqrt{2}\right)}$

A1 $BC^2 = 224$ May be implied by $BC = \sqrt{224}$ or $4\sqrt{14}$

A1 $BC = 4\sqrt{14}$

If you see a candidate start $BC^2 = (5.66)^2 + (16.97)^2 - 2(5.66)(16.97)\cos 60° \Rightarrow BC = 4\sqrt{14}$ award M1, A1, A0

Question Number	Scheme	Marks
1(a)	$AC^2 = 10^2 + 8^2 - 2\times10\times8\cos65° \Rightarrow AC = ..$	M1
	$AC = 9.8...,\Rightarrow AC = 9.82\,\text{km}\,(9820\text{m})$ (to nearest 10 m)	A1,A1 **(3)**
(b)	$\dfrac{\sin A}{8} = \dfrac{\sin 65°}{'9.817..'} \Rightarrow A =$ $\angle A = \text{awrt } 47.6°$ | $\dfrac{\sin C}{10} = \dfrac{\sin 65°}{'9.817..'} \Rightarrow C =$ $\angle C = \text{awrt } 67.4°$	M1 A1
	$\Rightarrow$ Bearing = awrt $132.4°$	A1ft **(3)**
		(6 marks)
Alt (b)	$\cos A = \dfrac{10^2 + AC^2 - 8^2}{2\times10\times AC} \Rightarrow A = ...$ OR $\cos C = \dfrac{8^2 + AC^2 - 10^2}{2\times8\times AC} \Rightarrow C = ...$	M1

(a)

M1 Uses the cosine rule, or otherwise to find *AC*. The rule, if stated, must be correct. If it is not stated it must be of the correct form. Accept $AC^2 = 10^2 + 8^2 - 2\times10\times8\cos65° \Rightarrow AC = ..$
It is possible to find *AC* by other methods, eg dropping a perpendicular from *A* to a point *X* on *BC*. For M1 to be scored it must be a full method Eg A full method could be; find *AX* by using $\sin 65°$, *BX* by $\cos 65°$, and *CX* by subtraction of *BX* from 8. The M1 is finally scored after an application of Pythagoras' theorem to find *AC*.

A1 Accept answers rounding or truncating to $AC = 9.8...$ (km)

A1 Accept $AC = 9.82\,\text{km}$ *or* 9820m . Both the accuracy and the units are necessary.

(b)

M1 Uses the sine rule (or cosine rule) with their answer for *AC* to find angle *A* or angle *C*.
Accept $\dfrac{\sin A}{8} = \dfrac{\sin 65°}{'9.817..'} \Rightarrow A =$ or $\cos A = \dfrac{10^2 + '9.817'^2 - 8^2}{2\times10\times'9.817'} \Rightarrow A = ...$
Accept $\dfrac{\sin C}{10} = \dfrac{\sin 65°}{'9.817..'} \Rightarrow C =$ or $\cos C = \dfrac{8^2 + '9.817'^2 - 10^2}{2\times8\times'9.817'} \Rightarrow C = ...$
In the sine rule the sides and angles need to be correctly matched

A1 Accept $\angle A = \text{awrt } 47.6°$ or $\angle C = \text{awrt } 67.4°$
Don't be overly concerned with the labelling of the angle

A1ft Awrt $132.4°$ or follow through on their $(180 - A)°$ if they found *A* or $(65 + C)°$ if they found *C*.