Question	Scheme	Marks	AOs
4(a)	e.g. $6.4^2 = 8^2 + 13^2 - 2(8)(13)\cos ABC$	M1	1.1b
	$(\text{angle } ABC =)\ \cos^{-1}\left(\frac{8^2+13^2-6.4^2}{2\times 8\times 13}\right) = 0.394$ (radians)*	A1*	1.1b
		(2)	
(b)	e.g. $(\text{Area}(ABC) =)\ \frac{1}{2}(8)^2(0.394)\ \ (= \text{awrt } 12.6)$ **or** $(\text{Area}(ABD) =)\ \frac{1}{2}(8)(13)\sin 0.394\ \ (= \text{awrt } 20.0)$	M1	1.1b
	$(\text{Area}(R) =)\ \frac{1}{2}(8)(13)\sin 0.394 - \frac{1}{2}(8)^2(0.394) = \ldots$	dM1	3.1a
	$(\text{Area}(R) =)$ awrt 7.34 to 7.37	A1	1.1b
		(3)	
			(5 marks)

Notes

It is acceptable in this question to work in degrees and convert if necessary.
NB Angle *ABC* in degrees is 22.591…°

(a)

M1: Attempts to use the cosine rule with values correctly placed. May be implied by, e.g.,

$$\cos\theta = \frac{8^2+13^2-6.4^2}{2\times 8\times 13} \text{ or } \cos^{-1}\left(\frac{6.4^2-8^2-13^2}{-2\times 8\times 13}\right)$$

Condone slips in substitution if a correct cosine formula is seen. The placement of the values should be correct. So, condone e.g. a missing 2 once a correct cosine formula is seen.

Alt 1: attempts the cosine rule and finds angle *ADB* $(= \text{awrt } 0.5 \text{ or } 29°)$ **or** angle *BAD* $(= \text{awrt } 2.2 \text{ or } 2.3 \text{ or } 129°)$ **and** uses the sine rule correctly with angle *ABC* involved.

Alt 2: attempts the cosine rule and finds angle *ADB* $(= \text{awrt } 0.5 \text{ or } 29°)$ **and** angle *BAD* $(= \text{awrt } 2.2 \text{ or } 2.3 \text{ or } 129°)$ **and** sums angles *ADB*, *BAD*, and *ABC* to π (or 180°)

Alt 3: using Pythagoras **and** simultaneous equations to find the length of *AN* or *BN* (see diagram on the next page) **and** uses e.g. $\cos ABC = \frac{BN}{8}$ or $\sin ABC = \frac{AN}{8}$

A1*: cso Correct proof.

If starting with $6.4^2 = 8^2 + 13^2 - 2(8)(13)\cos ABC$ then there must be an intermediate line such as

- $\cos ABC = \frac{8^2+13^2-6.4^2}{2\times 8\times 13}$ or angle $ABC = \cos^{-1}\left(\frac{8^2+13^2-6.4^2}{2\times 8\times 13}\right)$
- $\cos ABC = \text{awrt } 0.92$ or $\frac{4801}{5200}$
- angle *ABC* = awrt 0.3943

The minimum required is e.g. $\cos^{-1}\left(\frac{8^2+13^2-6.4^2}{2\times 8\times 13}\right)$ or $\cos\theta = \frac{8^2+13^2-6.4^2}{2\times 8\times 13} \to \theta = 0.394$

both of which score M1A1*.

The final value must be 0.394 and not e.g. 0.3943. There should be no obvious incorrect statements in the proof e.g. $\cos(0.92) = 0.394$ and no obvious incorrect work.

Allow the use of, e.g., θ, *x*, or even e.g. *A* throughout. Mention of radians is not required.
Those working in degrees and achieve 22.6 can convert to 0.394 without calculation for M1A1

	Attempts via verification e.g. $AD^2 = 8^2 + 13^2 - 2(8)(13)\cos 0.394 \rightarrow AD = \text{awrt } 6.4$ score maximum M1A0*.
(b)	**Note: you may need to check the diagram for working.**
M1:	Attempts the area of the sector **or** the area of the triangle *ABD* via a **correct** method. May be implied by a full attempt at the area of *R*. The sector area may be implied by $\frac{1576}{125}$ or by $\frac{0.394}{2\pi} \times \pi \times 8^2$ or $\frac{22.6}{360} \times \pi \times 8^2$ The angle *ABC* is given in the question as 0.394 and should be used (or a more accurate value). Do not allow use of a different value for angle *ABC* (other than the angle in degrees). There are many acceptable alternative approaches to find the area of triangle *ABD*, e.g. using their angle *ADB* **or** their angle *BAD* **or** using right-angled triangles e.g. $\frac{1}{2}(13)(\text{"3.07"})$ **or** $\frac{1}{2}(\text{"7.39"})(\text{"3.07"}) + \frac{1}{2}(\text{"5.614"})(\text{"3.07"})$ and could be implied by e.g. 11.3 + 8.6 **Alternatively**, attempts the area of the triangle *ACD* $\left(\text{e.g. } \frac{1}{2}(5)(6.4)\sin\text{"0.501"} = \text{awrt } 7.68\right)$ **or** the area of the segment (in sector *ABC*) $\left(\frac{1}{2}(8^2)(0.394) - \frac{1}{2}(8^2)\sin 0.394 = \text{awrt } 0.324\right)$ via a **correct** method. The area of the triangle *ABC* alone is insufficient for this mark. Note that $\sin 0.394$ might be seen as $\sqrt{1-\left(\frac{4801}{5200}\right)^2}$ For values, see the diagram below.
dM1:	Complete and correct method for the area of *R*. Requires correct attempts at both the area of the sector **and** the area of the triangle *ABD* **and** subtraction of the two values (or expressions). Allow sector – triangle *ABD* if this is then recovered by making the area positive. Alternatively, correct attempts at both the area of the triangle *ACD* **and** the area of the segment (in sector *ABC*) **and** subtraction of the two values (or expressions). Condone slips in substitution provided a correct formula is seen. May be implied by a correct answer.
A1:	awrt 7.34 to 7.37 no units required but penalise incorrect units. ISW after an acceptable answer is seen.

Helpful Diagram: