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2- Correction key

1

A

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2

Example of an appropriate solution

Find the measure of \angle BON:

$$m \angle MOA = m \angle BON = \frac{90^\circ - 64^\circ}{2} = 13$$

Find the measure of \angle MAO:

$$m \angle MAO = 180^\circ - (60^\circ + 13^\circ) = 107^\circ$$

Find the measure of segment AO:

$$\begin{aligned}\frac{\sin (\angle MAO)}{m \overline{MO}} &= \frac{\sin (\angle AMO)}{m \overline{AO}} \\ \frac{\sin (107^\circ)}{100 \text{ cm}} &= \frac{\sin (60^\circ)}{m \overline{AO}} \\ m \overline{AO} &= \frac{\sin (60^\circ) \times 100 \text{ cm}}{\sin (107^\circ)} \\ m \overline{AO} &\approx \frac{0.8660 \times 100 \text{ cm}}{0.9563} \\ m \overline{AO} &\approx 90.56 \text{ cm}\end{aligned}$$

Find the measure of \angle OAB:

$$m \angle OAB = 180^\circ - 107^\circ = 73^\circ$$

Find the measure of \angle ABO:

$$m \angle ABO = 180^\circ - (64^\circ + 73^\circ) = 43^\circ$$

Find the measure of segment AB:

$$\frac{\sin (\angle ABO)}{m \overline{AO}} = \frac{\sin (\angle AOB)}{m \overline{AB}}$$

$$\frac{\sin (43^\circ)}{90.56 \text{ cm}} = \frac{\sin (64^\circ)}{m \overline{AB}}$$

$$m \overline{AB} = \frac{\sin (64^\circ) \times 90.56 \text{ cm}}{\sin (43^\circ)}$$

$$m \overline{AB} \approx \frac{0.8988 \times 90.56 \text{ cm}}{0.6820}$$

$$m \overline{AB} \approx 119.35 \text{ cm}$$

Answer: From Point A to Point B, the marble travelled 119.3 cm

Accept answers in the range [119, 120].

Note: A student can also approach this solution by finding the measure of segment BO instead of segment AO.

A student can also approach this solution by finding $200 - (m \overline{MA} + m \overline{BN})$.

Students who have found the measure of either segment AO or segment BO have shown they have a partial understanding of the problem.

3 Example of an appropriate method

Measure of $\angle CBD$

$$180^\circ - (85^\circ + 35^\circ) = 60^\circ$$

Length of segment BD

$$\frac{m \overline{BD}}{\sin 35^\circ} = \frac{5.2}{\sin 60^\circ}$$

$$m \overline{BD} = 3.444 \text{ metres}$$

Length of segment AB

$$\frac{m \overline{AB}}{3.444} = \cos 15^\circ$$

$$m \overline{AB} = 3.326 \text{ metres}$$

Length of segment BE

$$m \overline{BE} = 2.5(3.326) = 8.316$$

Answer: To the nearest tenth of a metre, pole BE measures **8.3** metres.

Note: The student who determined the length of \overline{BD} , 3.44 metres, has demonstrated a partial understanding of the problem.

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5 Example of an appropriate method

$\angle SRL = 55^\circ$ (corresponding angles, parallel lines)

In small $\triangle SLR$

$$\sin 55^\circ = \frac{1030 \text{ m}}{m \overline{SR}}$$

$$m \overline{SR} \sin 55^\circ = 1030 \text{ m}$$

$$m \overline{SR} = \frac{1030 \text{ m}}{\sin 55^\circ}$$

$$m \overline{SR} = 1257.4 \text{ m}$$

In the large $\triangle SMB$

$$\cos 55^\circ = \frac{980 \text{ m}}{m \overline{SB}}$$

$$m \overline{SB} \cos 55^\circ = 980 \text{ m}$$

$$m \overline{SB} = \frac{980 \text{ m}}{\cos 55^\circ}$$

$$m \overline{SB} = 1708.6 \text{ m}$$

$$m \overline{RB} = (1708.6 - 1257.4) \text{ m}$$

$$m \overline{RB} = 451$$

Answer: Because there are many ways to do this problem, and answers will vary as a result of rounding, accept 450 m to 453 m.

6

Example of an appropriate method

Order lengths of fencing and divide into quintiles:

1 2 3 | 5 11 12 | 20 21 27 | 29 30 31 | 33 34 36

Using Hero's formula to find area of triangle:

$$\begin{aligned} A &= \sqrt{34(34 - 20)(34 - 21)(34 - 27)} \\ &= \sqrt{34 \times 14 \times 13 \times 7} \\ &= \sqrt{43\,316} \\ &= 208.12 \end{aligned}$$

Answer: Rupert will enclose 208.1 m² of land.

Note: Do not deduct any marks for incorrect rounding.

7

Example of an appropriate solution

Matthew's route

Distance from town A to cabin

$$\cos 25^\circ = \frac{x}{125}$$

$$x \approx 113.29$$

Distance from cabin to town B

$$\sin 25^\circ = \frac{x}{125}$$

$$x \approx 52.83$$

Total distance

$$113.29 + 52.83 = 166.12 \text{ km}$$

Difference in distances

$$166.12 - 142.26 = 23.86 \text{ km}$$

Answer: To the nearest tenth, the difference between the two routes is 23.9 km.

Cynthia's route

Measure of angle A

$$\frac{50}{\sin A} = \frac{125}{\sin 120^\circ}$$

$$\sin A \approx 0.3464$$

$$m \angle A \approx 20.27^\circ$$

Measure of angle B

$$180^\circ - (120^\circ + 20.27^\circ) = 39.73^\circ$$

Distance from town A to restaurant

$$\frac{125}{\sin 120^\circ} = \frac{b}{\sin 39.73^\circ}$$

$$b \approx 92.26$$

Total distance

$$92.26 + 50 = 142.26 \text{ km}$$

Note: Accept answers in the range of 23.8 km to 24 km.

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8 Example of an appropriate method

Length of segment AD

$$\cos 20^\circ = \frac{m \overline{AD}}{7.5}$$

$$m \overline{AD} = 7.0476\dots$$

Measure of angle ABD

$$m \angle ABD = 180^\circ - m \angle BAD - m \angle BDA$$

$$m \angle ABD = 180^\circ - 20^\circ - 30^\circ$$

$$m \angle ABD = 130^\circ$$

Length of segment BD

$$\frac{m \overline{BD}}{\sin \angle BAD} = \frac{m \overline{AD}}{\sin \angle ABD}$$

$$\frac{m \overline{BD}}{\sin 20^\circ} = \frac{7.0476}{\sin 130^\circ}$$

$$m \overline{BD} \approx 3.146$$

Answer: Rounded to the nearest tenth, the length of the beam represented by segment BD is 3.1 m.

Note: Students who use an appropriate method in order to determine the length of segment AD have shown that they have a partial understanding of the problem.

Do not penalize students who did not round off their final answer or who made a mistake in rounding it off.

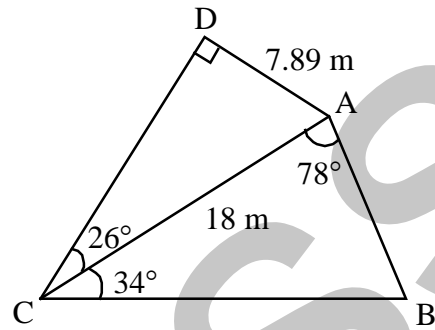
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9 Example of an appropriate solution

Measure of side CD

$$\cos 26^\circ = \frac{m \overline{CD}}{18}$$

$$m \overline{CD} \approx 16.18$$



Area of triangle ADC

$$A = \frac{b \times h}{2} \approx \frac{16.18 \times 7.89}{2} \approx 63.83$$

Measure of angle B

$$m \angle B = 180^\circ - (78^\circ + 34^\circ) = 68^\circ$$

Measure of segment AB

$$\frac{18}{\sin 68^\circ} = \frac{m \overline{AB}}{\sin 34^\circ}$$

$$m \overline{AB} \approx 10.86$$

Measure of segment BC

$$\frac{m \overline{BC}}{\sin 78^\circ} = \frac{18}{\sin 68^\circ}$$

$$m \overline{BC} \approx 18.99$$

Area of triangle ABC

$$\text{Perimeter} \approx 18 + 10.86 + 18.99 = 47.85$$

$$\frac{1}{2} \text{ perimeter} \approx 23.93 = p$$

$$A = \sqrt{p(p - a)(p - b)(p - c)}$$

$$A \approx \sqrt{23.93(23.93 - 18.99)(23.93 - 18)(23.93 - 10.86)}$$

$$A \approx 95.72$$

Total area of plot

$$63.83 + 95.72 \approx 159.55\text{m}^2$$

Answer: Helen will need to buy 160 pieces of sods of grass.

10 Example of an appropriate method

Measure of segment AC

$$\tan 65^\circ = \frac{15}{m \overline{AC}}$$

$$m \overline{AC} = \frac{15}{\tan 65^\circ}$$

$$m \overline{AC} = 6.994... \approx 7$$

Measure of segment BC

$$m \overline{BC} \approx 7 - 4 = 3$$

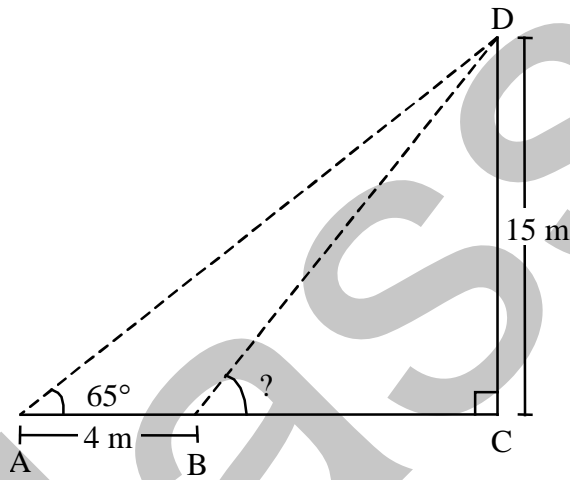
Angle of elevation of point B

$$\tan B = \frac{15}{3}$$

$$\tan B = 5$$

$$m \angle B = 78.69... \approx 79^\circ$$

Answer: The angle of elevation of the observer located at B is 79° .



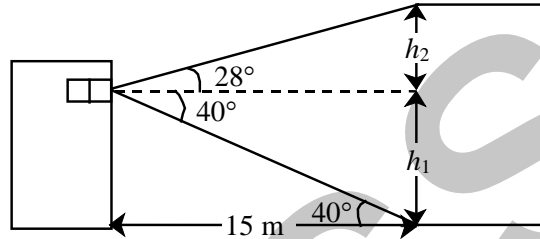
11 Example of an appropriate method

Height h_1

$$\tan 40^\circ = \frac{h_1}{15}$$

$$h_1 = 15 \tan 40^\circ$$

$$h_1 \approx 12.59$$



Height h_2

$$\tan 28^\circ = \frac{h_2}{15}$$

$$h_2 = 15 \tan 28^\circ$$

$$h_2 \approx 7.98$$

Height of the building

$$h_1 + h_2 \approx 20.57$$

Answer: The height of the building is 20.57 m.

12 Example of an appropriate method

Area of rectangle

$$A = L \times l$$

$$A = 100 \times 50$$

$$A = 5000$$

Area of triangle

Heron's formula: $\sqrt{p(p-a)(p-b)(p-c)}$

$$A = \sqrt{117(117-50)(117-72)(117-112)}$$

$$A \approx 1328.07$$

Total area

$A_t = \text{Area of rectangle} + \text{area of triangle}$

$$A_t \approx 5000 + 1328.07 = 6328.07$$

Asking price

$$\text{Price} \approx A_t \times 1.35 = 8542.89$$

Answer: To purchase this property, Julio must pay \$8542.89.

Accept any answer in the interval [\$8542.80, \$8542.94] also.

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13 Example of an appropriate method of solution

Measure of \overline{BC}

$$\frac{64.3}{\sin 100^\circ} = \frac{m \overline{BC}}{\sin 30^\circ}$$

$$m \overline{BC} \approx 32.65$$

Perimeter of triangle ABC

$$50 + 64.43 + 32.65 = 146.95$$

s = semi-perimeter

$$s \approx 73.47$$

Area of triangle ABC

$$A \approx \sqrt{73.47(73.47 - 64.3)(73.47 - 50)(73.47 - 32.64)} \quad (\text{Heron's formula})$$
$$\approx 803.5$$

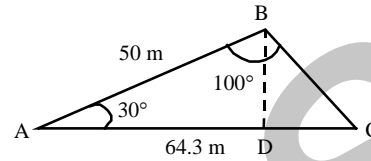
Answer Rounded to the nearest m^2 , the area of the plot of land is 804 m^2 .

Accept an answer in the interval [803, 804].

Alternate solution: By drawing an altitude \overline{BD} from B to \overline{AC} , as shown in the diagram, and using the fact that it is opposite a 30° angle, we find $m \overline{BD}$ to be $\frac{1}{2}(50) = 25$ m.

Using the formula for the area of a triangle $\frac{1}{2}$ Base \times Altitude

we obtain $\frac{1}{2}(25)(64.3) = 803.75$



\therefore Area of plot of land to the nearest m^2 is $804 m^2$

14 Example of an appropriate algebraic solution

Krystal's distance from the base of the house

$$\tan 20^\circ = \frac{4}{m \overline{AB}}$$

$$m \overline{AB} = \frac{4}{\tan 20^\circ} \approx 10.99 \text{ m}$$

Height of Krystal's house

$$\tan 40^\circ = \frac{m \overline{BD}}{10.99}$$

$$m \overline{BD} = 10.99 \tan 40^\circ \approx 9.22 \text{ m}$$

Distance from window to the roof of the house

$$m \overline{BD} - m \overline{BC} = 9.22 - 4 = 5.22 \approx 5.2 \text{ m}$$

Answer The distance from window to the roof of the house is 5.2 m.

15 Example of an appropriate algebraic solution

Volume of smaller box

$$l \times w \times h = 4 \times 2 \times 8 = 64 \text{ cm}^3$$

Ratio of volumes

$$\frac{1728}{64} = \frac{27}{1}$$

Ratio of edges

$$\sqrt[3]{\frac{27}{1}} = \frac{3}{1}$$

Height of larger box

$$\text{Height} = 8 \times 3 = 24 \text{ cm}$$

Answer The height of the larger box is 24 cm .

16 Work : (example)

Measure of \overline{BC}

$$\cos 53^\circ = \frac{m \overline{BC}}{15}$$

$$m \overline{BC} = 15 \cos 53^\circ$$

Measure of \overline{BD}

$$\sin 53^\circ = \frac{m \overline{BD}}{m \overline{BC}}$$

$$m \overline{BD} = 15 \cos 53^\circ \times \sin 53^\circ$$

$$m \overline{BD} \approx 7.2$$

Result The measure of segment BD is about 7.2 cm.

17 Example of an appropriate solution

Measure of \overline{BD} and of angle ADB

$$m \overline{BD} = m \overline{CD} = 5 \text{ cm}$$

$$m \angle ADB = 180^\circ - (50^\circ + 35^\circ) = 95^\circ$$

Measure of \overline{AD}

$$\frac{5}{\sin 50^\circ} = \frac{m \overline{AD}}{\sin 35^\circ}$$

$$m \overline{AD} = \frac{5 \times \sin 35^\circ}{\sin 50^\circ} \approx 3.74$$

Measure of \overline{AB}

$$\frac{5}{\sin 50^\circ} = \frac{m \overline{AB}}{\sin 95^\circ}$$

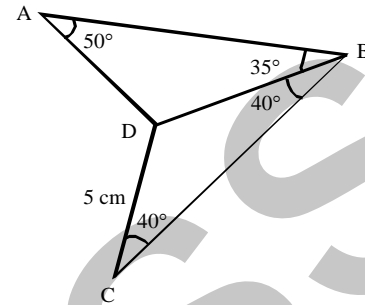
$$m \overline{AB} = \frac{5 \times \sin 95^\circ}{\sin 50^\circ} \approx 6.5$$

Measure of half the perimeter (p)

$$p \approx \frac{1}{2} (5 + 3.74 + 6.5) = 7.62$$

Area of triangle ABD

$$S = \sqrt{p(p-a)(p-b)(p-c)}$$



$$S \approx \sqrt{7.62(7.62 - 5)(7.62 - 3.74)(7.62 - 6.5)}$$

$$S = \sqrt{86.76} \approx 9.31$$

Answer The area of triangle ABD is 9.31 cm².

Accept answers that fall within the interval [9.21 , 9.32].

18 Example of an appropriate solution

I would find :

- The area of the triangle using Heron's formula

- Area $\Delta = \frac{b \times h}{2}$

- Solve for h , $h = \frac{2 \times \text{area } \Delta}{b}$

Any other plausible answer is acceptable.

Example of an appropriate solution

Example 1

Measure of \overline{DC} :

$$\sin \angle A = \frac{m \overline{DC}}{m \overline{AC}}$$

$$m \overline{DC} = m \overline{AC} \times \sin \angle A \text{ or}$$

$$m \overline{DC} = 1 \text{ m} \times \sin 46.57^\circ$$

$$m \overline{DC} \approx 0.7262 \text{ m}$$

Measure of $\angle ABC$

$$\sin \angle B = \frac{m \overline{DC}}{m \overline{BC}} \quad \sin \angle B \approx \frac{0.7262}{1.5} = 0.4841$$

$$m \angle B \approx 28.95^\circ$$

Final answer : Angle ABC measures 28.95° .

or

Example 3

The area of $\triangle ABC$ using Heron's formula

Example 2

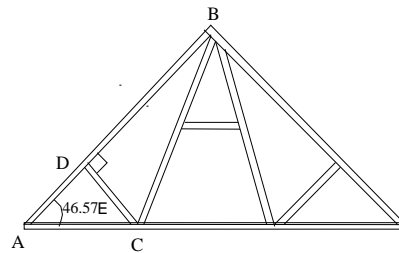
$$\frac{1.5 \text{ m}}{\sin 46.57^\circ} = \frac{1 \text{ m}}{\sin \angle ABC}$$

$$\sin \angle ABC = \frac{1 \times \sin 46.57^\circ}{1.5}$$

$$\sin \angle ABC \approx 0.4841 \text{ m}$$

$$m \angle ABC \approx 28.95^\circ$$

Final answer Angle ABC measures 28.95° .



$$P = \frac{1}{2}(1 + 2 + 1.5) = 2.25$$

$$\text{Area} = \sqrt{2.25(2.25 - 1)(2.25 - 2)(2.25 - 1.5)}$$

$$\text{Area} \approx 0.7262 \text{ m}^2$$

Measure of \overline{DC}

$$\text{Area} = \frac{B \times h}{2}$$

$$\text{Height} = \frac{2 \times \text{area}}{\text{base}}$$

$$\text{Height} \approx \frac{2 \times 0.7262}{2} = 0.7262$$

Measure of $\angle B$

$$\sin \angle B = \frac{m \overline{DC}}{m \overline{BC}} \quad \sin \angle B \approx \frac{0.7262}{1.5} = 0.4841$$

$$m \angle B \approx 28.95^\circ$$

Final answer Angle ABC measures 28.95° .

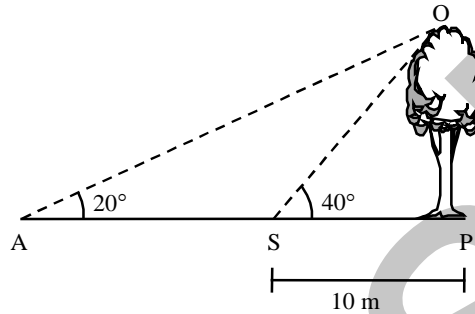
20

Example of an appropriate method

Height of the tree

$$\tan 40^\circ = \frac{m \overline{OP}}{10}$$

$$m \overline{OP} \approx 8.39$$



Distance between Anthony and the tree

$$\tan 20^\circ \approx \frac{8.39}{m \overline{AP}}$$

$$m \overline{AP} \approx 23.05$$

Distance between Anthony and Steven

$$23.05 - 10 \approx m \overline{AE}$$

$$13.05 \approx m \overline{AE}$$

Answer The distance between Anthony and Steven is 13.05 metres.

Accept all result in [13, 13.1].

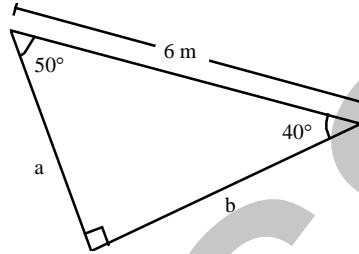
21

Example of an appropriate method

Length of side a

$$\sin 40^\circ = \frac{a}{6}$$

$$a = 6 \sin 40^\circ \approx 3,86$$



Length of side b

$$\sin 50^\circ = \frac{b}{6}$$

$$b = 6 \sin 50^\circ \approx 4,60$$

$$\text{Area of triangle: } \frac{a \times b}{2} \approx \frac{3.86 \times 4.60}{2} = 8.878$$

Quantity of paint

$$1 \text{ L covers } 2 \text{ m}^2$$

$$8.878 \div 2 = 4.439 \quad (4 \text{ litres is not enough; she must buy 5 litres})$$

Answer Mara will have to buy 5 litres of paint.

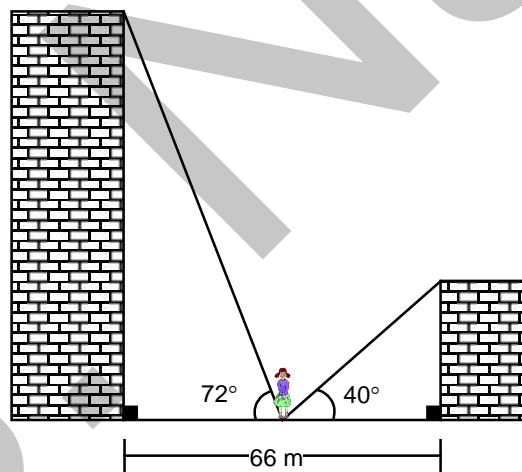
1

Marie-Pierre is standing exactly half way between two office-building towers. These towers are on opposite sides of the street. Using a clinometer (a device used to measure angles) she calculates the angle formed by the top of each building. The two readings are 72° and 40° .

The distance between the two buildings is 66 metres.

What is the difference between the heights of the two buildings?

Round your answer to the nearest tenth of a metre.



A) 73.9 m

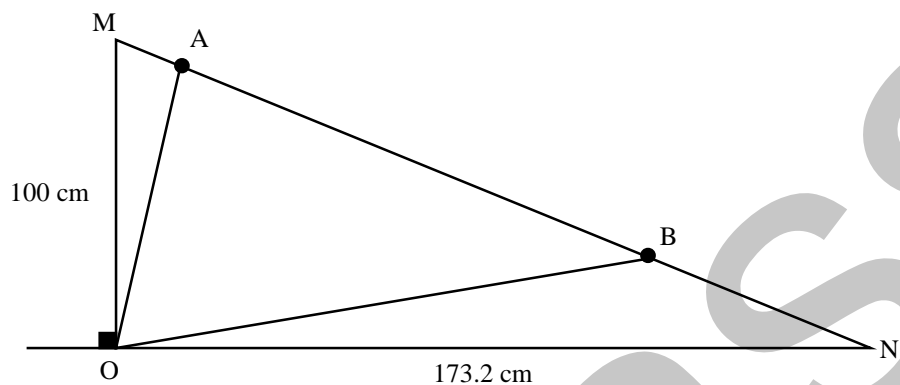
C) 129.3 m

B) 101.6 m

D) 147.7 m

2

In a science experiment, a class wanted to calculate the distance a marble travelled from point A to point B on a slope with the measurements shown below:



To help her students, the teacher gave out additional information:

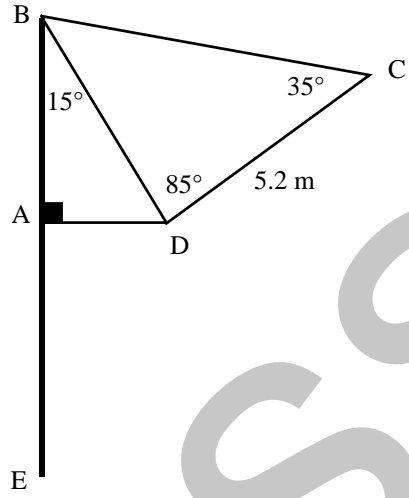
- $m \angle AMO = 60^\circ$
- $m \angle AOB = 64^\circ$
- $\angle MOA \cong \angle BON$

How many centimetres did the marble travel from point A to point B?

Show all your work.

3 A drawing of a banner is shown in the diagram on the right.

Pole BE, supporting the banner, is 2.5 times the length of segment AB.



What is the length of pole BE to the nearest tenth of a metre?

Show all your work

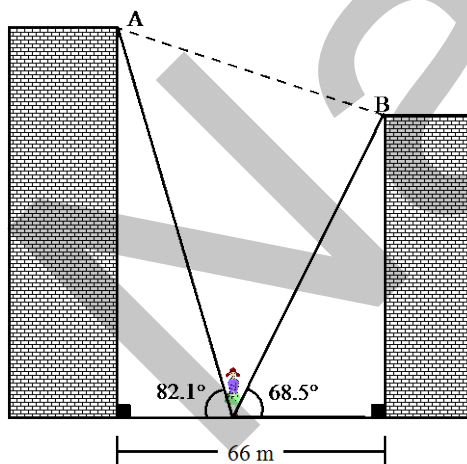
4

Marie-Pierre is standing exactly half way between two office-building towers. These towers are on opposite sides of the street. Using a clinometer (a device used to measure angles) she calculates the angle formed by the top of each building. The two readings are 82.1° and 68.5° .

The distance between the two buildings is 66 metres.

What is the shortest distance between the two rooftops, represented by \overline{AB} ?

Round your answer to the nearest tenth of a metre.



A) 167.6 m

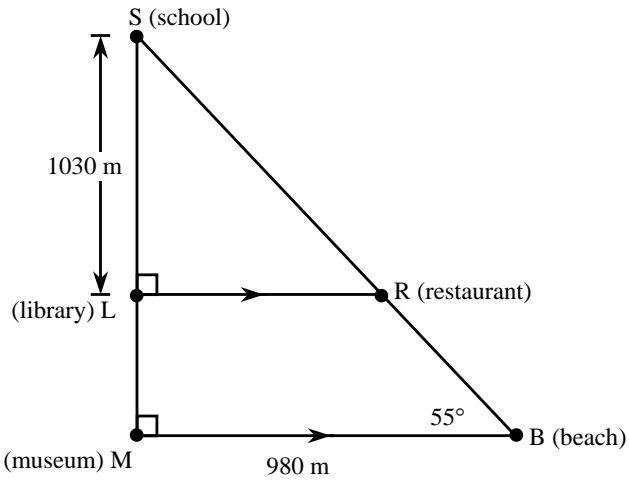
C) 222.6 m

B) 210.0 m

D) 246.8 m

5

A street map of a part of a small town is shown below.



- Two of the streets are parallel.
- The distance from the museum to the beach is 980 m .
- The distance from the school to the library is 1030 m .

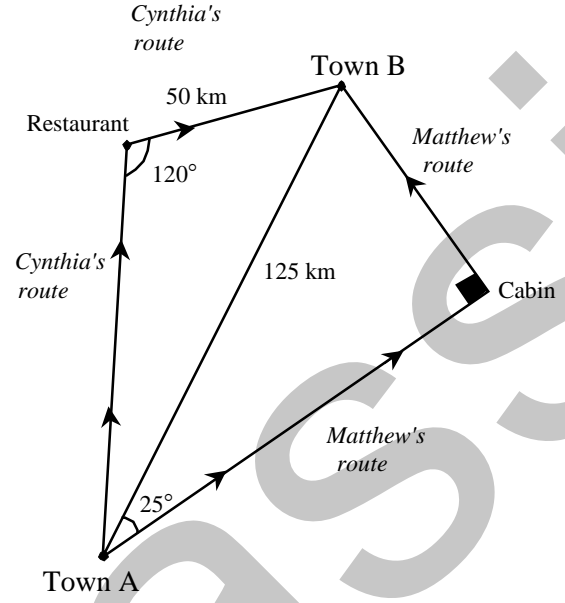
What is the shortest distance from the beach to the restaurant?

Round your answer to the nearest metre.

7

Cynthia and Matthew each rode from town A to town B on their bicycles. Their routes are represented in the diagram on the right. The diagram is not drawn to scale.

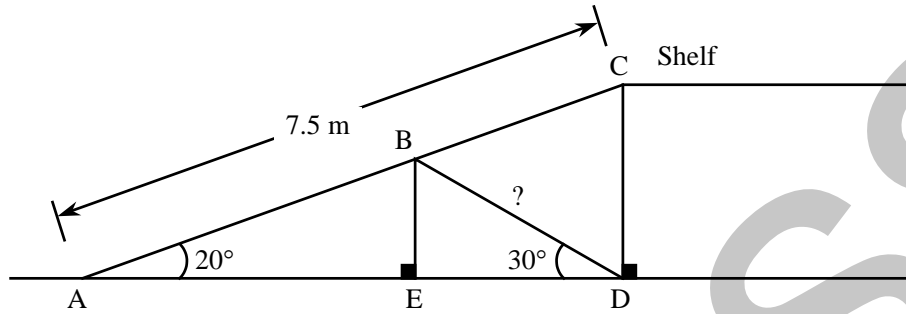
The direct route between the two towns is 125 km.



To the nearest tenth, how much longer is Matthew's route than Cynthia's?

Show all your work.

- 8 The structure represented in the diagram below is used in a warehouse to lift objects off the ground and onto a shelf.

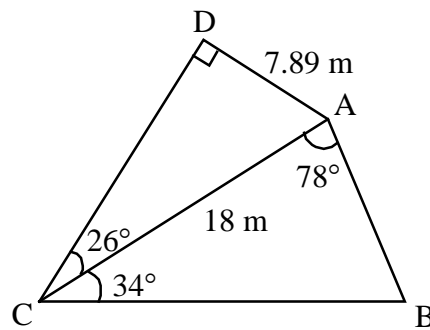


Rounded to the nearest tenth, what is the length of the beam represented by segment BD?

Show all your work.

- 9 Helen's plot of land is represented by the diagram on the right.

She wants to cover it with pieces of grass sod that each measure 1 square metre.



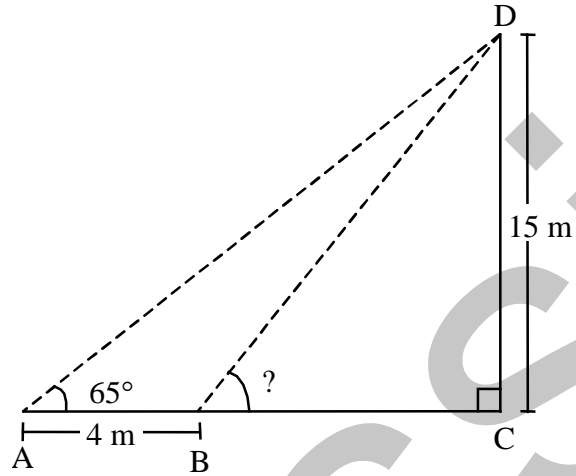
How many pieces of grass sod will Helen need to buy?

Show all your work.

- 10 Two bird watchers, 4 metres apart, are located at positions A and B as shown on the figure.

Both are looking at the top of a 15-metre tree.

From point A, the angle of elevation is 65° .

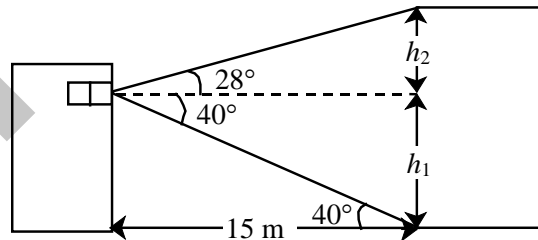


What is the angle of elevation of the bird watcher at position B?

Show all your work.

- 11 Michel's room is on the second floor of his house. His neighbour lives in a flat-roofed building 15 metres away.

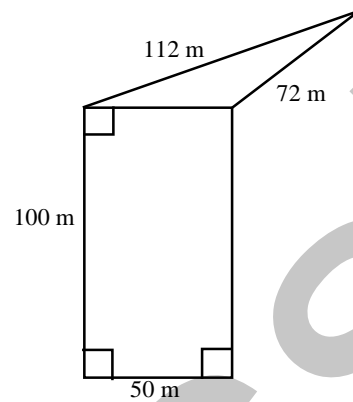
From his window, Michel sees the top corner of his neighbour's building at an angle of elevation of 28° , as shown in the diagram on the right. The angle of depression at which he sees the bottom corner of his neighbour's building is 40° .



What is the height of this building?

Show all your work.

- 22 Julio wants to purchase a waterfront property on Lake Malartic. The surveyor gave him a plan of the dimensions of the property.



The asking price is \$1.35 per square metre.

How much would it cost Julio to buy this property?

Show all your work.

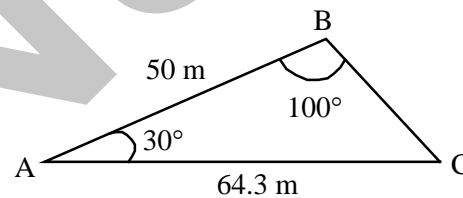
- 13 Triangle ABC shown on the right represents a plot of land in which:

$$m \overline{AC} = 64.3 \text{ m}$$

$$m \overline{AB} = 50 \text{ m}$$

$$m \angle B = 100^\circ$$

$$m \angle BAC = 30^\circ$$

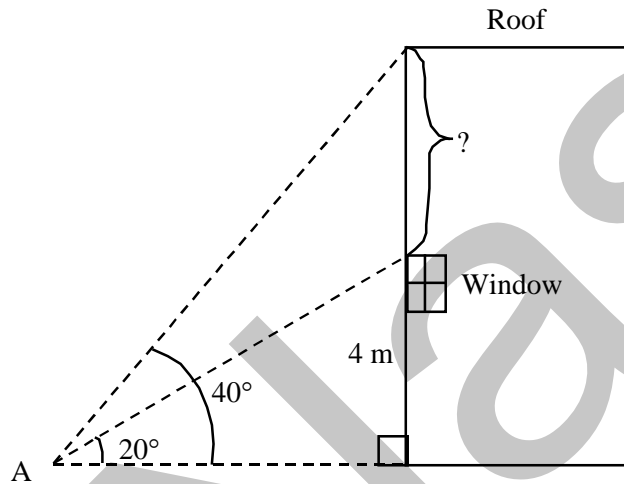


To the nearest m^2 , what is the area of the plot of land?

14

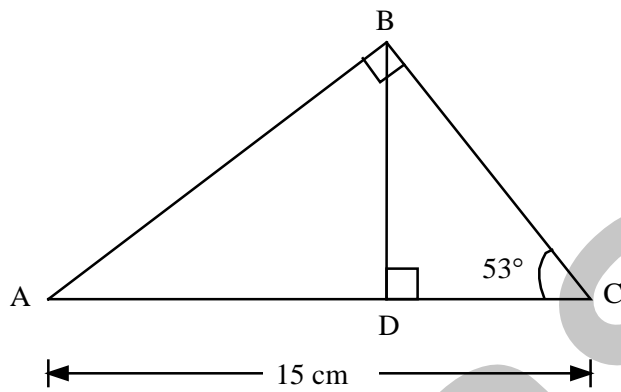
Krystal, standing at point A, uses a clinometer to determine the angles of elevation of her window and the roof of her house. These are 20° and 40° respectively. She knows that the top of her window is 4 m above the ground. This situation is represented in the diagram below.

To the nearest tenth of a metre, how far is it from the top of her window to the roof of her house?



16

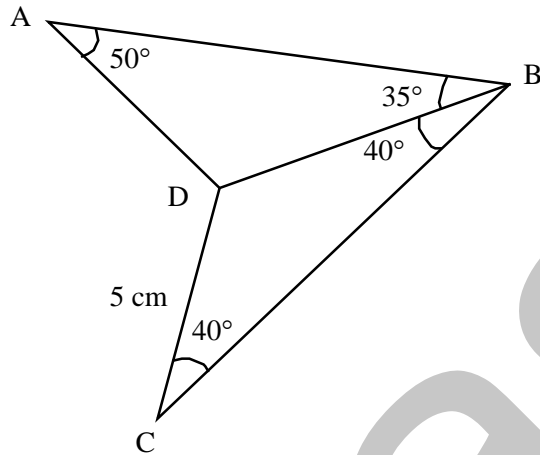
Given triangle ABC with right angle B.



What is the measure of segment BD ?

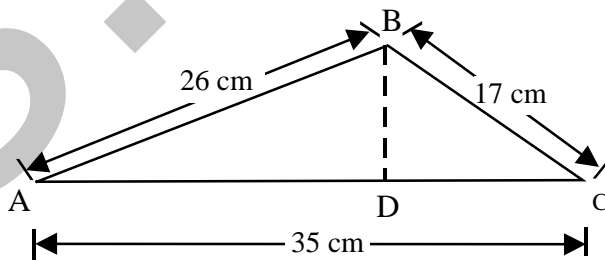
Show your work.

- 17 Determine the area of triangle ABD illustrated in the diagram below.



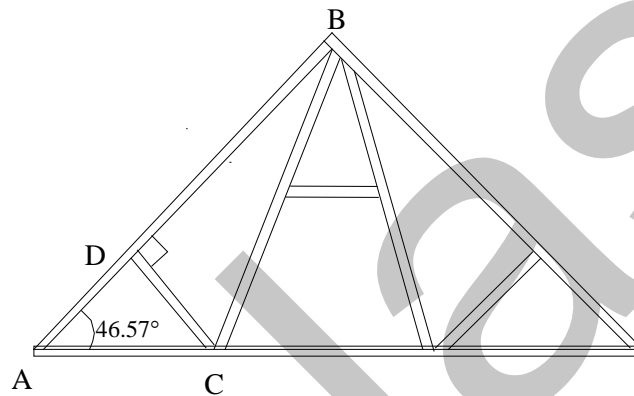
Show all your work.

- 18 Without doing any calculations, explain how you would determine that the height of \overline{BD} relative to \overline{AC} is 12.07 cm.



19 The diagram below represents the roof of a barn. The measure of angle BAC is 46.57° .

What is the measure of angle ABC given that \overline{BC} measures 1.5 m, \overline{AB} measures 2 m and \overline{AC} measures 1 m?



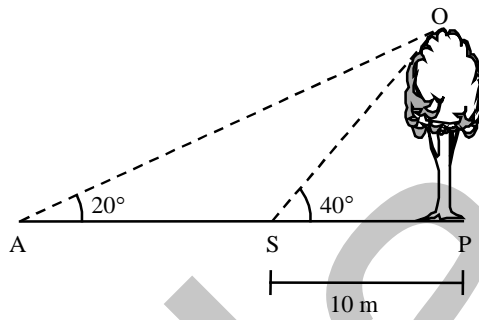
Show all the work needed to solve the problem.

20

From point A, Anthony observes a bird at the top of the tree at an angle of 20° .

From point S, Steven observes the same bird at an angle of 40° .

Steven is 10 metres from the foot of the tree.

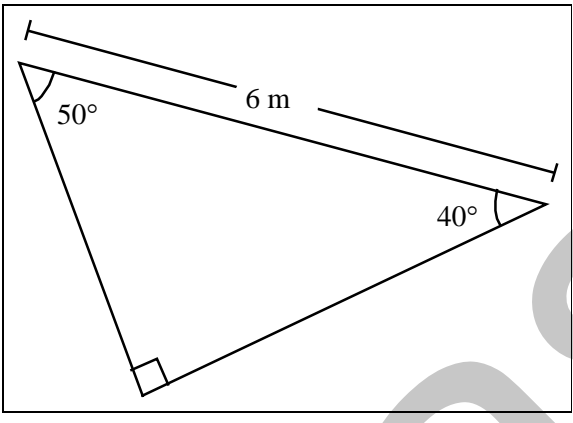


What is the distance between Anthony and Steven?

Show all your work.

21

Mara has been given the job of decorating her company's staff room. She wants to draw a triangle on one of the walls and paint it blue. A sketch of the wall with the measures of the triangle is shown below.



Mara must find the area of the blue triangle before buying the paint. Each litre of paint covers 2 square metres. The paint she wants is sold only in 1-litre containers.

How many litres of paint will Mara have to buy?

Show all your work.