

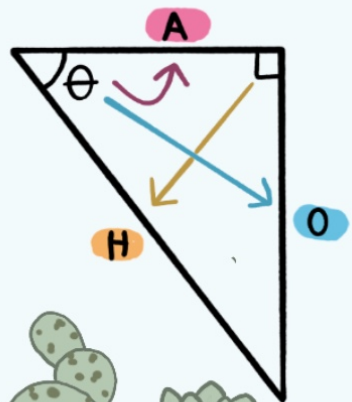
	0°	30°	45°	60°	90°
$\sin \theta$	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
$\cos \theta$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
$\tan \theta$	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	Not defined
$\operatorname{cosec} \theta$	Not defined	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1
$\sec \theta$	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	Not defined
$\cot \theta$	Not defined	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0

Trigonometry

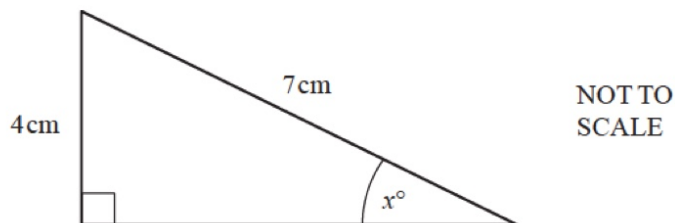
$$\sin \theta = \frac{O}{H}$$

$$\cos \theta = \frac{A}{H}$$

$$\tan \theta = \frac{O}{A}$$



Question 1



[2]

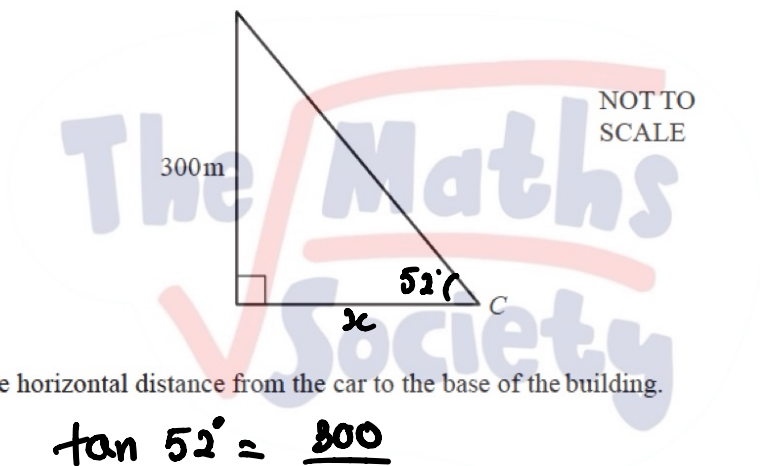
Calculate the value of x .

$$\sin x = \frac{4}{7}$$

$$x = \sin^{-1}\left(\frac{4}{7}\right) = 34.85^\circ$$

Question 2

From the top of a building, 300 metres high, the angle of depression of a car, C, is 52° .



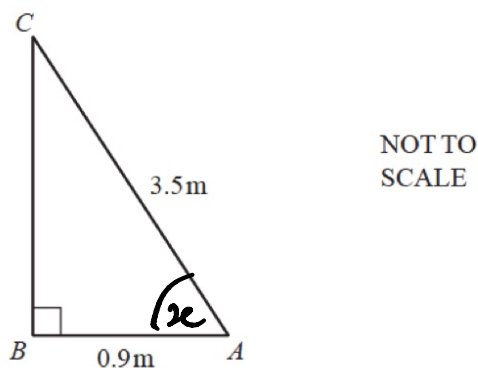
Calculate the horizontal distance from the car to the base of the building.

[3]

$$\tan 52^\circ = \frac{300}{x}$$

$$x = \frac{300}{\tan 52^\circ} = 234.385 \text{ m}$$

Question 3



[2]

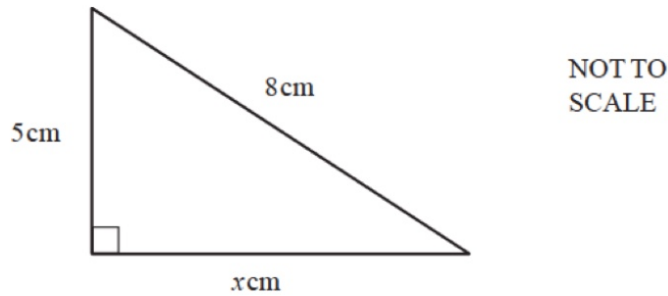
Calculate angle BAC .

$$\cos x = \frac{0.9}{3.5}$$

$$x = \cos^{-1}\left(\frac{0.9}{3.5}\right) = 75.099^\circ$$

The Maths Society

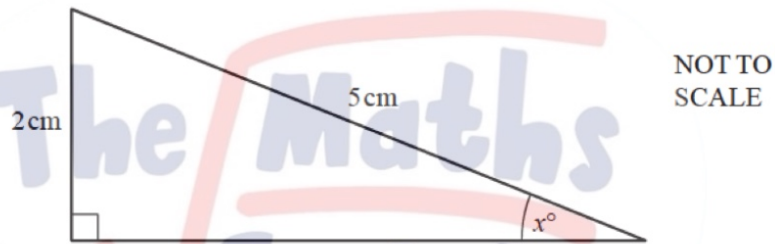
Question 4



Calculate the value of x.

$$x = \sqrt{8^2 - 5^2} = \sqrt{39} = 6.2449 \text{ cm} \quad [3]$$

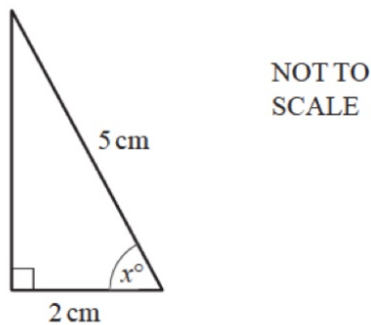
Question 5



Calculate the value of x.

$$\sin x = \frac{2}{5}$$
$$x = \sin^{-1}\left(\frac{2}{5}\right) = 23.5781^\circ \quad [2]$$

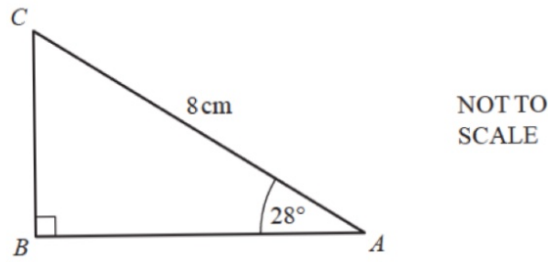
Question 6



Calculate the value of x.

$$\cos x = \frac{2}{5}$$
$$x = \cos^{-1}\left(\frac{2}{5}\right) = 66.4218^\circ \quad [2]$$

Question 7



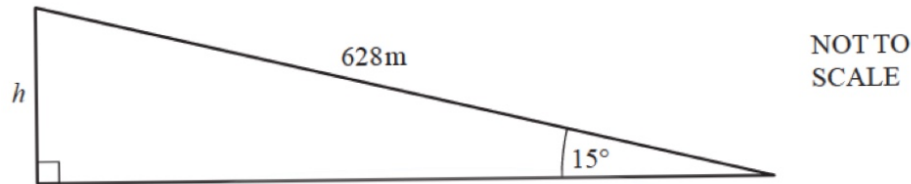
Calculate the length of AB .

[2]

$$\cos 28^\circ = \frac{AB}{8}$$

$$AB = 8 \times \cos 28^\circ = 7.0636$$

Question 8



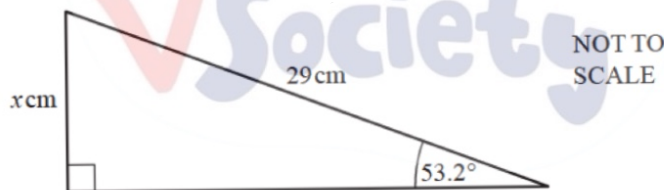
Calculate the length h .

Give your answer correct to 2 significant figures.

[3]

$$\sin 15^\circ = \frac{h}{628} \quad | \quad h = 628 \times \sin 15^\circ = 162.5 \text{ m}$$

Question 9



[2]

Calculate the value of x .

$$\cos 53.2^\circ = \frac{x}{29}$$

$$x = 29 \times \cos 53.2^\circ = 17.3717 \text{ cm}$$

Question 10

In the right-angled triangle ABC , $\cos C = \frac{4}{5}$. Find angle A .

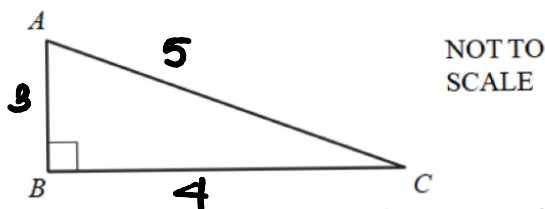
[2]

$$\sin A = \frac{4}{5}$$

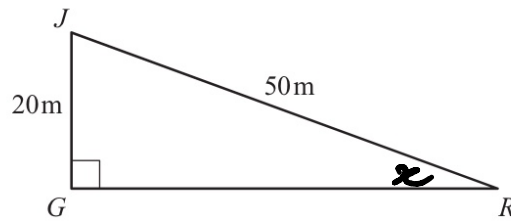
$$A = \sin^{-1}\left(\frac{4}{5}\right)$$

5

$$A = 53.1301^\circ$$



Question 1



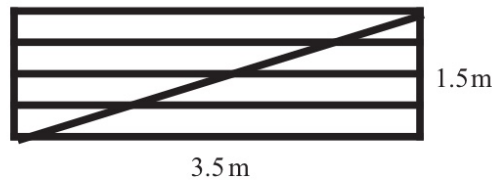
NOT TO SCALE

JGR is a right-angled triangle. $JR = 50\text{m}$ and $JG = 20\text{m}$.
Calculate angle JRG .

$$\sin x = \frac{20}{50}$$

$$x = \sin^{-1}\left(\frac{20}{50}\right) = 23.5782^\circ$$

Question 2



NOT TO SCALE

[2]

The diagram represents a rectangular gate measuring 1.5m by 3.5m .
It is made from eight lengths of wood.

Calculate the total length of wood needed to make the gate.

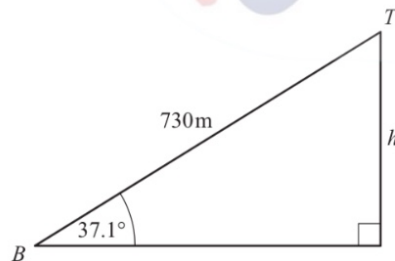
$$\sqrt{3.5^2 + 1.5^2} = 3.808\text{ m}$$

$$\begin{aligned} \text{total length} &= 3 + 17.5 + 3.808 \\ &= 24.308\text{ m} \end{aligned}$$

[3]

Question 3

The diagram represents the ski lift in Queenstown New Zealand.



NOT TO SCALE

(a) The length of the cable from the bottom, B , to the top, T , is 730 metres.

The angle of elevation of T from B is 37.1° .

Calculate the change in altitude, h metres, from the bottom to the top.

[2]

$$\sin 37.1^\circ = \frac{h}{730} \quad \left| \quad \begin{aligned} h &= 730 \times \sin 37.1^\circ \\ &= 440.3918\text{ m} \end{aligned} \right.$$

(b) The lift travels along the cable at 3.65 metres per second.

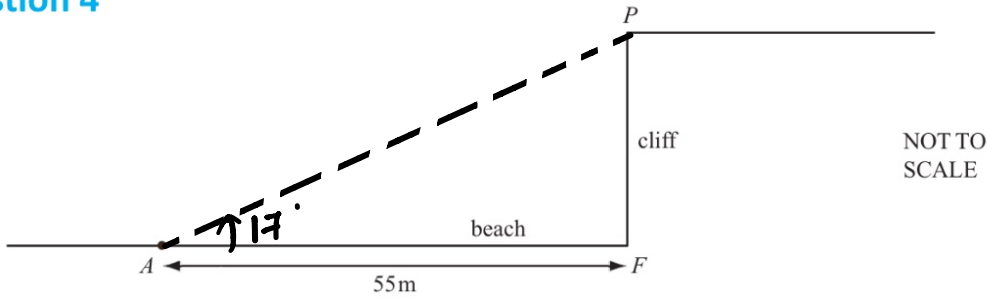
Calculate how long it takes to travel from B to T .

$$\frac{730}{3.65} = 200\text{s} = 3\text{min } 20\text{s}$$

Give your answer in minutes and seconds.

[2]

Question 4



The diagram shows a point P at the top of a cliff.
 The point F is on the beach and vertically below P .
 The point A is 55m from F , along the horizontal beach.
 The angle of elevation of P from A is 17° .

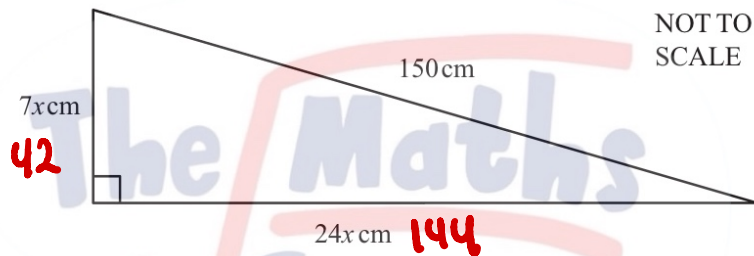
Calculate PF , the height of the cliff.

[3]

$$\tan 17^\circ = \frac{PF}{55}$$

$$PF = 55 \times \tan 17^\circ = 16.8152 \text{ m}$$

Question 5



The right-angled triangle in the diagram has sides of length $7x$ cm, $24x$ cm and 150 cm.

(a) Show that $x^2 = 36$.

[2]

$$150^2 = (7x)^2 + (24x)^2$$

$$22500 = 49x^2 + 576x^2$$

$$625x^2 = 22500$$

$$x^2 = \frac{22500}{625} = 36$$

(b) Calculate the perimeter of the triangle.

[1]

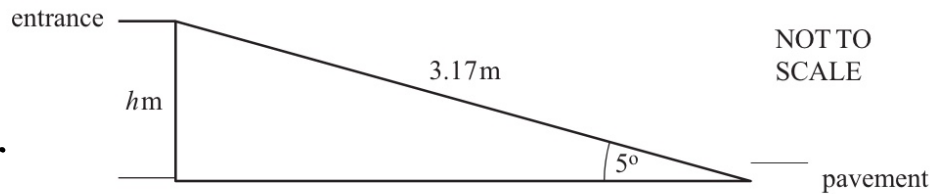
$$x = 6, \quad P = 336 \text{ cm}$$

Question 6

$$\sin 5^\circ = \frac{h}{3.17}$$

$$h = 3.17 \times \sin 5^\circ$$

$$= 0.2763 \text{ m}$$



A shop has a wheelchair ramp to its entrance from the pavement.
 The ramp is 3.17 metres long and is inclined at 5° to the horizontal.
 Calculate the height, h metres, of the entrance above the pavement.
 Show all your working.

[2]

Question 7

Calculate the value of $(\cos 40^\circ)^2 + (\sin 40^\circ)^2$.

$$\cos^2 40^\circ + \sin^2 40^\circ = 1$$

$$\cos^2 x + \sin^2 x = 1$$

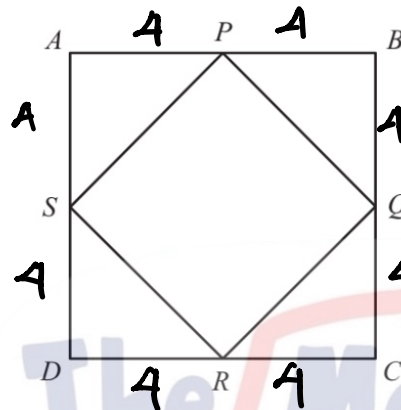
$$(\sin x)^2 = \sin^2 x$$

$$(\cos x)^2 = \cos^2 x$$

[2]

Question 8

A square $ABCD$, of side 8 cm, has another square, $PQRS$, drawn inside it. P, Q, R and S are at the midpoints of each side of the square $ABCD$, as shown in the diagram.



NOT TO SCALE

(a) Calculate the length of PQ .

$$PQ = \sqrt{4^2 + 4^2} = 4\sqrt{2} = 5.657 \text{ cm}$$

[2]

(b) Calculate the area of the square $PQRS$.

$$\text{Area} = 4\sqrt{2} \times 4\sqrt{2} = 32 \text{ cm}^2$$

[1]

Question 9

A mountain railway AB is of length 864 m and rises at an angle of 12° to the horizontal.

A train is 586 m above sea level when it is at A .

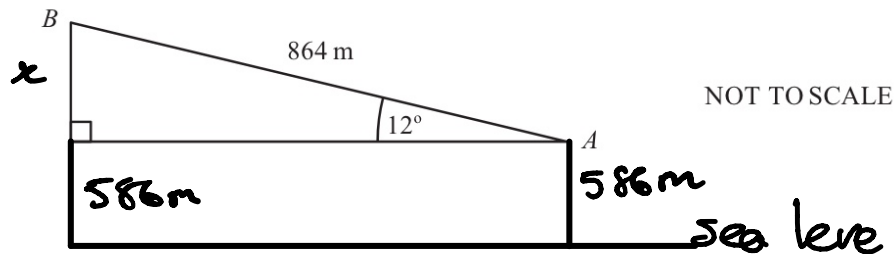
Calculate the height above sea level of the train when it reaches B .

[3]

$$\sin 12^\circ = \frac{x}{864}$$

$$x = 864 \times \sin 12^\circ$$

$$= 179.6357 \text{ m}$$

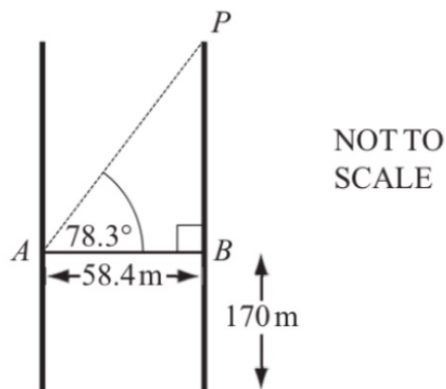


NOT TO SCALE

$$\text{height above sea level} = 179.6357 + 586 = 765.6357 \text{ m}$$

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Question 1



The line AB represents the glass walkway between the Petronas Towers in Kuala Lumpur. The walkway is 58.4 metres long and is 170 metres above the ground. The angle of elevation of the point P from A is 78.3° .

Calculate the height of P above the ground.

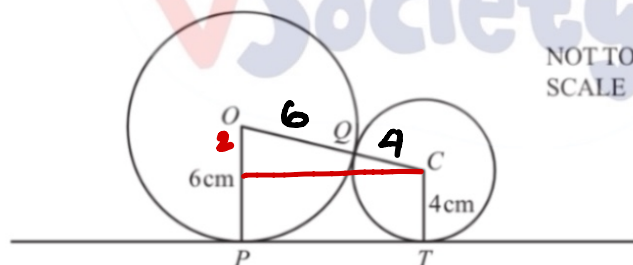
[3]

$$\tan 78.3^\circ = \frac{PB}{58.4}$$

height above ground

$$= 282.0029 + 170$$
$$= 452.0029 \text{ m}$$
$$PB = 58.4 \times \tan 78.3^\circ$$
$$= 282.0029 \text{ m}$$

Question 2



Two circles, centres O and C , of radius 6 cm and 4 cm respectively, touch at Q . PT is a tangent to both circles.

(a) Write down the distance OC .

[1]

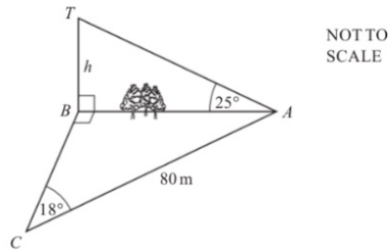
$$6 + 4 = 10 \text{ cm}$$

(b) Calculate the distance PT .

[3]

$$PT = \sqrt{10^2 - 4^2}$$
$$= \sqrt{96} = 4\sqrt{6} \text{ cm}$$

Question 3



Mahmoud is working out the height, h metres, of a tower BT which stands on level ground. He measures the angle TAB as 25° . He cannot measure the distance AB and so he walks 80 m from A to C , where angle $ACB = 18^\circ$ and angle $ABC = 90^\circ$.

Calculate

(a) the distance AB ,

$$\sin 18^\circ = \frac{AB}{80}$$

$$AB = 80 \times \sin 18^\circ = 24.7214 \text{ m}$$

[2]

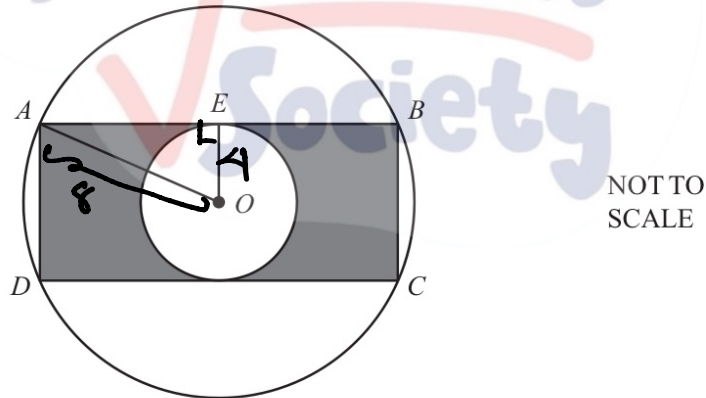
(b) the height of the tower, BT .

$$\tan 25^\circ = \frac{h}{AB}$$

$$h = 24.7214 \times \tan 25^\circ = 11.5278 \text{ m}$$

[2]

Question 4



A, B, C and D lie on a circle, centre O , radius 8 cm.
 AB and CD are tangents to a circle, centre O , radius 4 cm.
 $ABCD$ is a rectangle.

(a) Calculate the distance AE .

$$\sqrt{8^2 - 4^2} = 4\sqrt{3} = 6.928 \text{ cm}$$

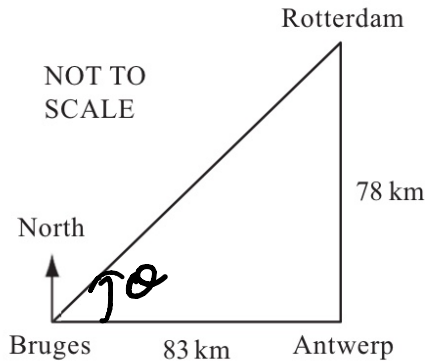
[2]

(b) Calculate the shaded area.

$$(8 \times 8\sqrt{3}) - (\pi(4)^2) = 60.5858 \text{ cm}^2$$

[3]

Question 5



Antwerp is 78 km due South of Rotterdam and 83 km due East of Bruges, as shown in the diagram.

Calculate

- (a) the distance between Bruges and Rotterdam, [2]

$$\sqrt{83^2 + 78^2} = 113.8991 \text{ km}$$

- (b) the bearing of Rotterdam from Bruges, correct to the nearest degree.

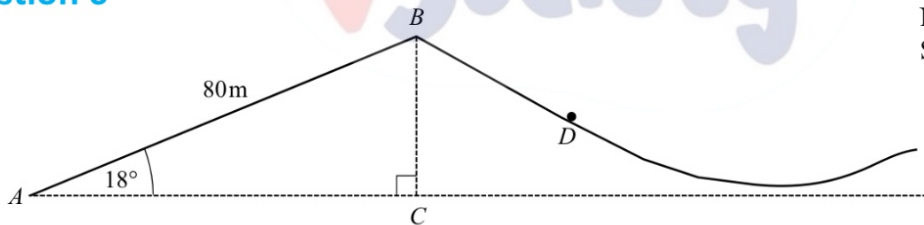
$$\tan \theta = \frac{78}{83}$$

$$\theta = \tan^{-1}\left(\frac{78}{83}\right) = 43.22^\circ$$

$$90^\circ - 43.22^\circ$$

$$\text{bearing} = 46.78$$

Question 6



The diagram shows the start of a roller-coaster ride at a fairground. A car rises from A to B along a straight track.

- (a) $AB = 80$ metres and angle $BAC = 18^\circ$. Calculate the vertical height of B above A . [2]

$$\sin 18 = \frac{BC}{80}$$

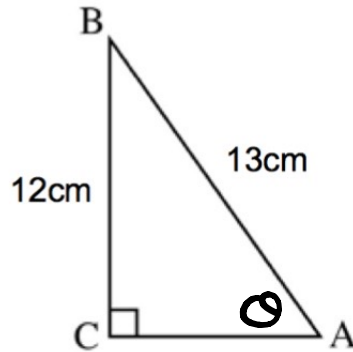
$$BC = 80 \times \sin 18 = 24.7214 \text{ m}$$

- (b) The car runs down the slope from B to D , a distance of s metres. Use the formula $s = t(p + qt)$ to find the value of s , given that $p = 4$, $t = 3$ and $q = 3.8$.

$$s = 3(4 + (3.8 \times 3)) = 46.2$$

[2]

1.



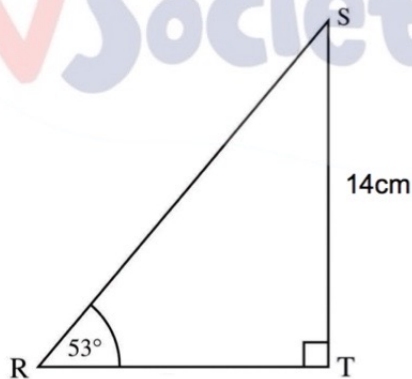
Calculate the size of angle BAC.

$$\sin \theta = \frac{12}{13}$$

$$\theta = \sin^{-1}\left(\frac{12}{13}\right) = 67.38^\circ$$

$$\underline{\underline{67.38^\circ}} \\ (3)$$

2.



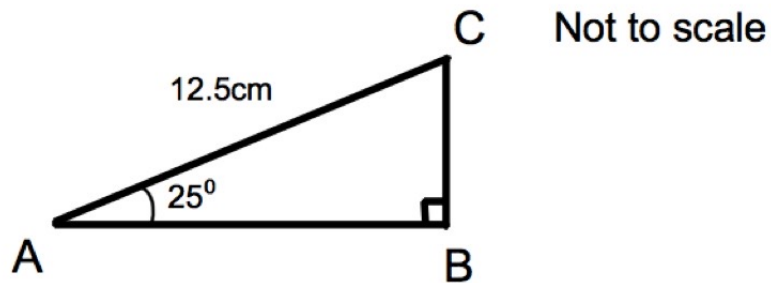
Find the length of the side RT in the triangle above.

$$\tan 53 = \frac{14}{RT}$$

$$RT = \frac{14}{\tan 53} = 10.5498$$

$$\underline{\underline{10.5498 \text{ cm}}} \\ (3)$$

3. Triangle ABC has a right angle.
 Angle BAC is 25°
 AC = 12.5cm

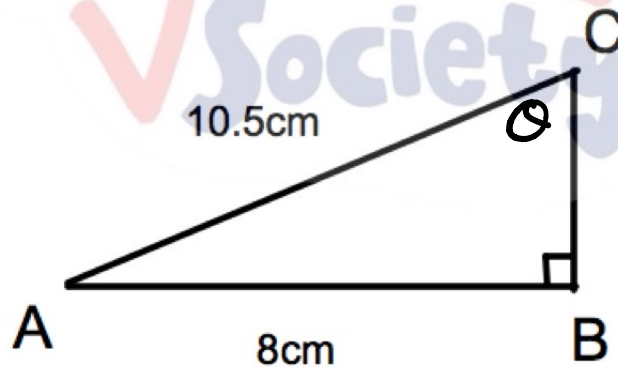


Calculate the length of AB

$$\cos 25^\circ = \frac{AB}{12.5}$$

$$AB = 12.5 \times \cos 25^\circ = 11.3288 \dots \text{cm} \quad (3)$$

4. ABC is a right-angled triangle.

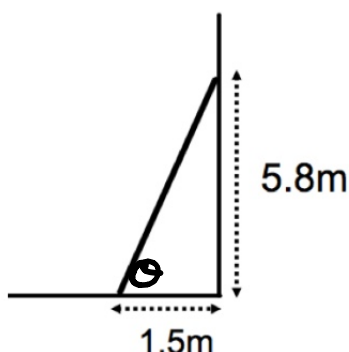


Calculate the size of angle ACB.

$$\sin \theta = \frac{8}{10.5}$$

$$\theta = \sin^{-1} \frac{8}{10.5} = 49.6324 \dots^\circ \quad (3)$$

5. A ladder is placed against a wall.
To be safe, it must be inclined at between 70° and 80° to the ground.



- (a) Is the ladder safe?

$$\tan \theta = \frac{5.8}{1.5}$$

$$\theta = \tan^{-1} \frac{5.8}{1.5} = 75.4998$$

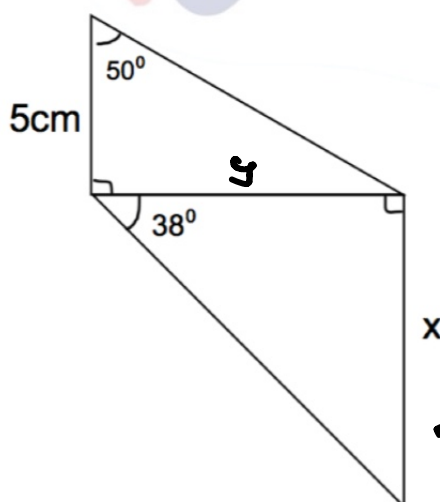
Yes.....
(3)

- (b) Calculate the length of the ladder.

$$\sqrt{5.8^2 + 1.5^2} = 5.9908$$

5.9908.....m
(3)

6. The diagram shows two right-angled triangles.



$$\tan 50^\circ = \frac{5}{y}$$

$$y = 5 \times \tan 50$$

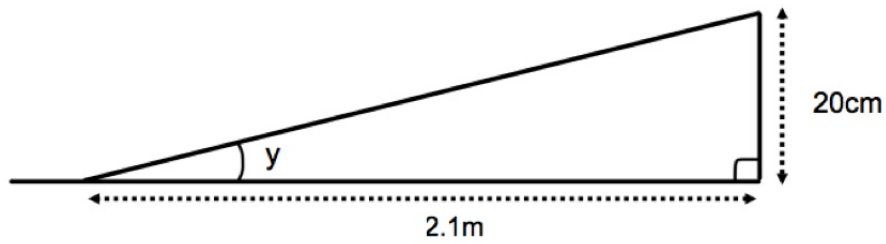
$$\tan 38^\circ = \frac{x}{y}$$

Calculate the value of x.

$$\begin{aligned} x &= y \tan 38^\circ \\ &= 5 \times \tan 50^\circ \times \tan 38^\circ \\ &= 4.6555 \end{aligned}$$

4.6555.....cm

7. A ramp is 2.1m long and 20cm high.



Calculate the size of angle y.

$$\tan y = \frac{20}{2.1}$$

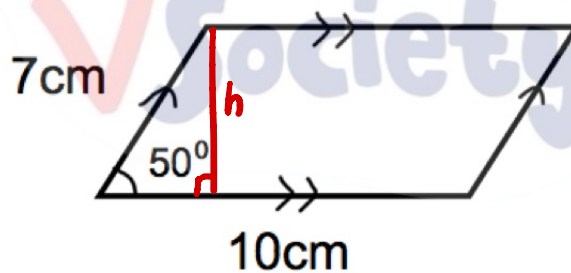
$$y = \tan^{-1}\left(\frac{20}{2.1}\right)$$

$$= 84.0059^\circ$$

$$\dots\dots\dots 84.0059^\circ$$

(3)

8. Shown below is a parallelogram.



Calculate the area of the parallelogram.

$$\sin 50^\circ = \frac{h}{7}$$

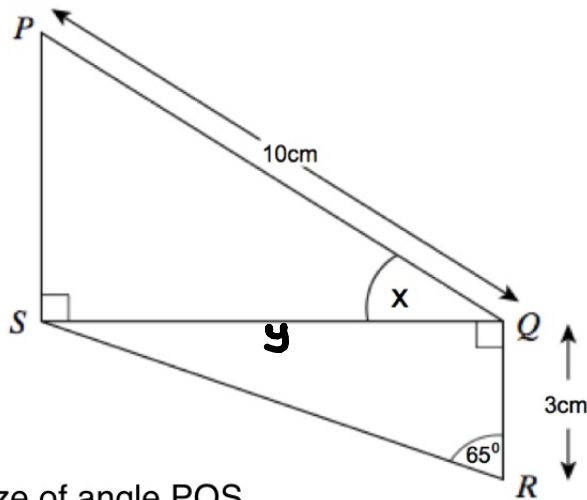
$$h = 5.36$$

$$A = 53.6$$

$$\dots\dots\dots 53.6 \dots\dots \text{cm}^2$$

(5)

9. Two right-angled triangles are shown below.
 PQ is 10cm.
 QR is 3cm.
 Angle QRS is 65°



Calculate the size of angle PQS

$$\tan 65^\circ = \frac{y}{3}$$

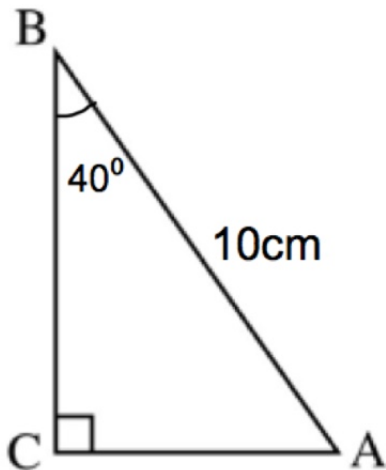
$$y = 3 \tan 65^\circ = 6.43$$

$$\cos x = \frac{y}{10}$$

$$x = \cos^{-1}\left(\frac{6.43}{10}\right) = 49.98^\circ$$

..... 49.98°
(5)

10. The diagram shows a right-angled triangle ABC. (Non-calculator question)



Angle	Sine	Cosine	Tangent
40°	0.643	0.766	0.839
50°	0.766	0.643	1.192

$$\cos 40^\circ = \frac{BC}{10}$$

$$BC = \cos 40^\circ \times 10$$

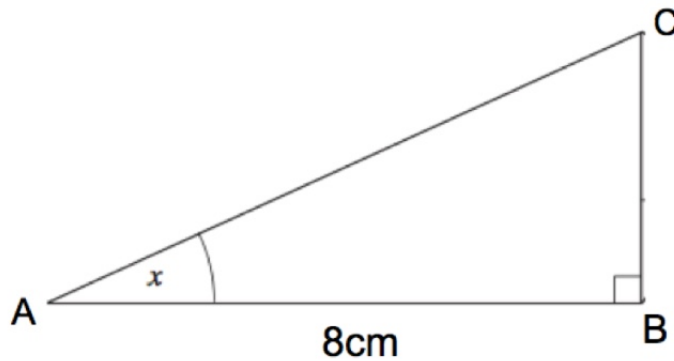
$$= 0.766 \times 10$$

$$= 7.66$$

Calculate the length of BC.

..... 7.66cm
(3)

11. Below is a right-angled triangle. (Non-calculator question)
 $\tan x = 0.6$
 AB is 8cm



Work out the length of BC

$$\tan x = \frac{BC}{8}$$

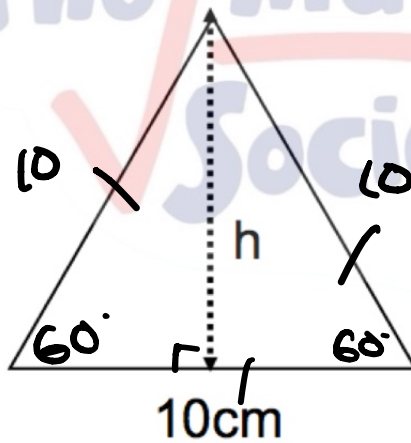
$$BC = 8 \tan x$$

$$= 8 \times 0.6 = 4.8$$

$$\dots\dots\dots 4.8 \dots\dots\dots \text{cm}$$

(3)

12. Below is an equilateral triangle



(a) Calculate the height of the triangle.

$$\sin 60 = \frac{h}{10}$$

$$h = 10 \sin 60 = 5\sqrt{3}$$

$$= 8.66$$

$$\dots\dots\dots 8.66 \dots\dots\dots \text{cm}$$

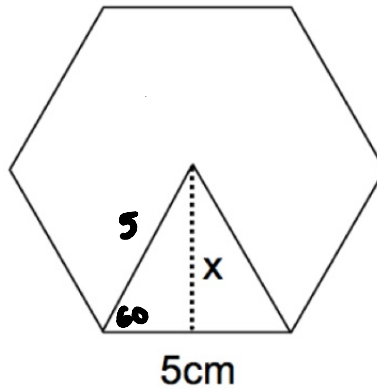
(3)

(b) Calculate the area of the triangle.

$$\frac{1}{2} \times 10 \times 8.66 = 43.301$$

$$\dots\dots\dots 43.301 \dots\dots\dots \text{cm}^2$$

13. A regular hexagon can be divided into 6 equilateral triangles. The diagram below shows one of the equilateral triangles.



- (a) Calculate the height, x , of the equilateral triangle above.

$$\sin 60 = \frac{x}{5}$$

$$x = 5 \sin 60 = 4.33$$

$$\dots 4.33 \dots \text{cm} \quad (3)$$

- (b) Calculate the area of the equilateral triangle.

$$\frac{1}{2} \times 4.33 \times 5 = 10.83$$

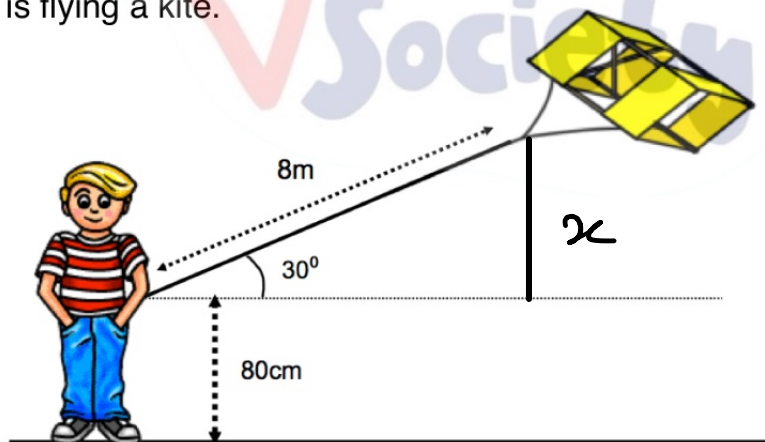
$$\dots 10.83 \dots \text{cm}^2 \quad (1)$$

- (c) Calculate the area of the hexagon.

$$6 \times 10.83 = 64.98$$

$$\dots 64.98 \dots \text{cm}^2 \quad (1)$$

14. A boy is flying a kite.



The string is held 80cm above the ground.
The kite is on a string which is 8m long.
The string makes an angle of 30° with the horizontal.

Calculate the height of the kite above the ground.

$$\sin 30 = \frac{x}{8}$$

$$0.8 + 4 = 4.8$$

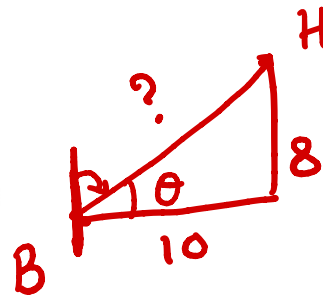
$$x = 8 \sin 30 = 4 \text{ m}$$

$$\dots 4.8 \dots \text{m} \quad (4)$$

15. A helicopter leaves Bristol and flies due east for 10 miles. Then the helicopter flies 8 miles north before landing.

(a) Work out the direct distance of the helicopter from Bristol.

$$\sqrt{10^2 + 8^2} = 12.81$$



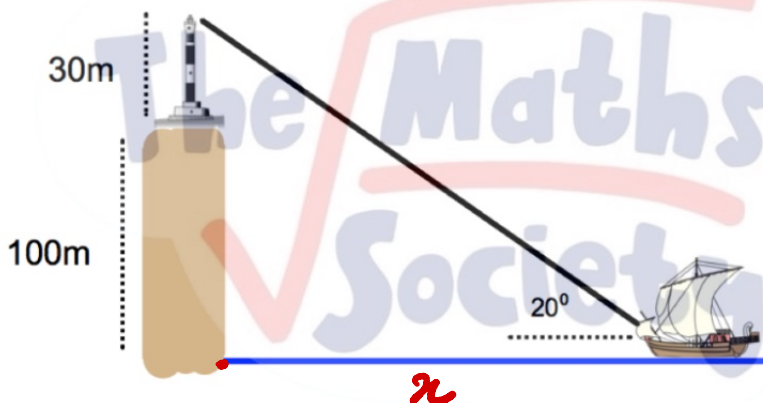
12.81...miles
(3)

(b) Calculate the bearing of the helicopter from Bristol.

$$\begin{aligned} \tan \theta &= \frac{8}{10} & 90 - 38.66 \\ \theta &= \tan^{-1} \frac{8}{10} & = 51.34 \\ & > 38.66 \end{aligned}$$

51.34...°
(3)

16. A boat is approaching a cliff with a lighthouse on top.



The cliff is 100m high and the lighthouse is 30m tall.

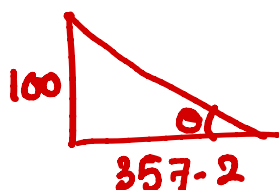
The angle of elevation from the boat to the top of the lighthouse is 20° .

(a) Calculate the distance of the boat to the base of the cliff.

$$\tan 20^\circ = \frac{130}{x} \quad \Bigg| \quad x = \frac{130}{\tan 20^\circ}$$

357.2...m
(3)

(b) Work out the angle of elevation from the boat to the top of the cliff.



$$\begin{aligned} \tan \theta &= \frac{100}{357.2} \\ \theta &= 15.6^\circ \end{aligned}$$

15.6...°
(3)