Lesmahagow High School

Mathematics Department

# S2

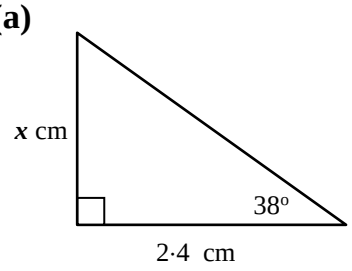
# Right Angled Triangle Trigonometry

## Applying Trigonometric Skills to Right-angled Triangles

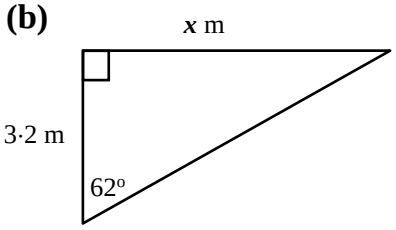
## Calculating a side in a right-angled triangle

**1.** Use the **tangent** ratio to calculate the length of the side marked ***x*** in these right-angled triangles.

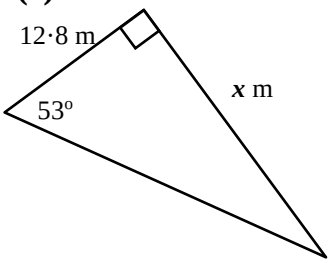
**(a)**




**(b)**




**(c)**

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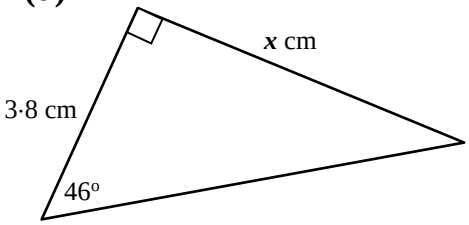


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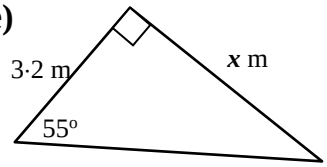


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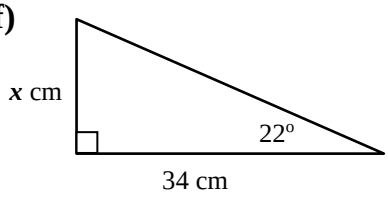


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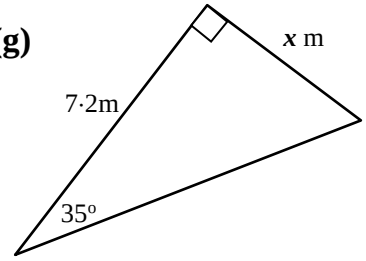


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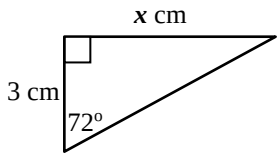
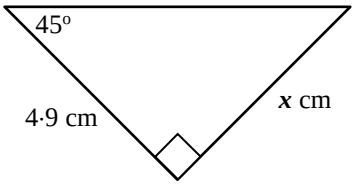
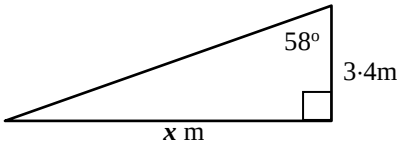



**(i)**

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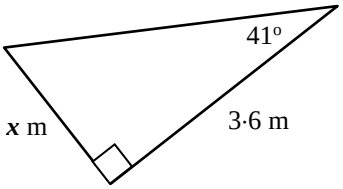


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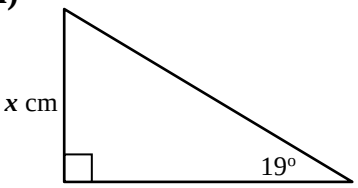


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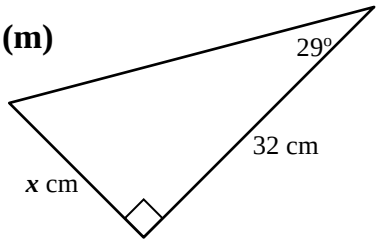


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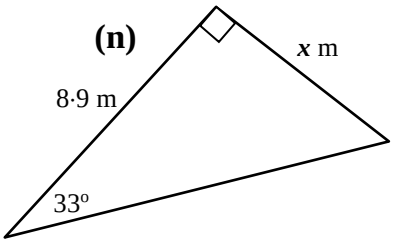


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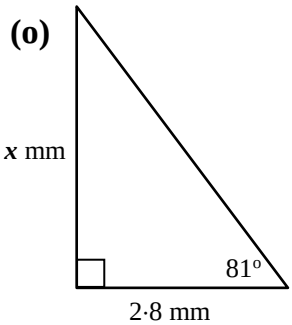
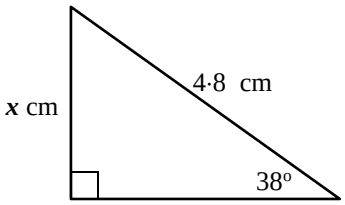


**2.** Use the **sine** ratio to calculate the length of the side marked ***x*** in these right-angled triangles.

**(a)**

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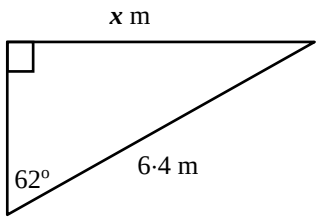


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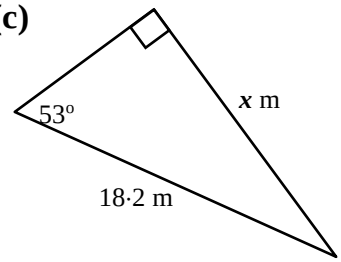


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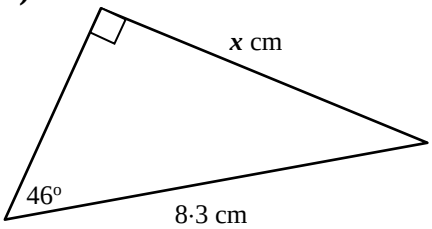


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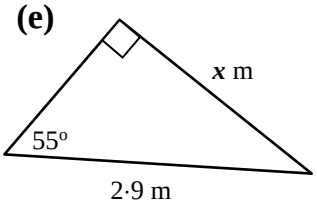


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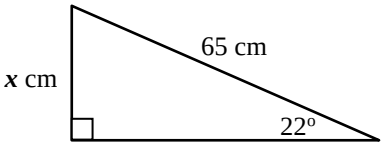


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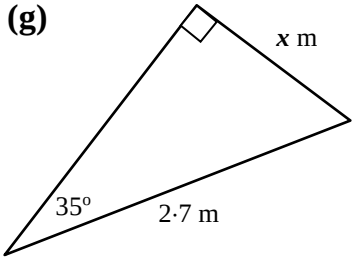


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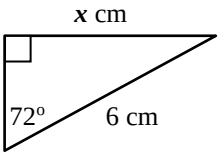


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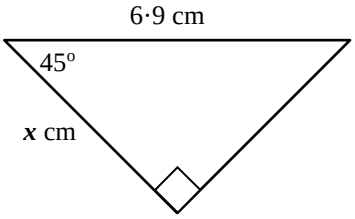


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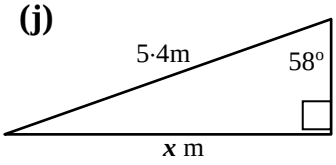


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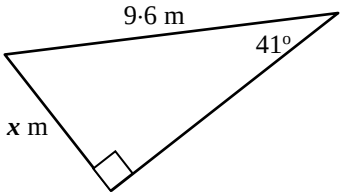


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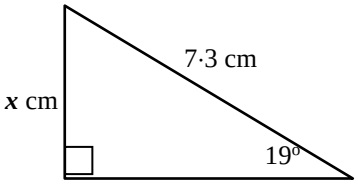


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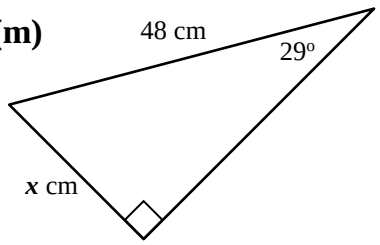


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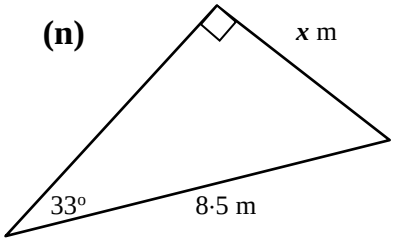


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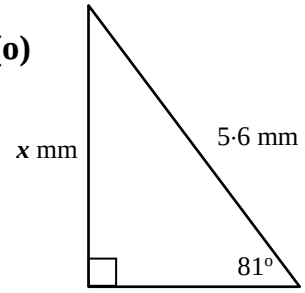
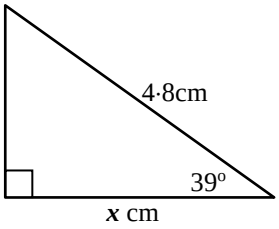
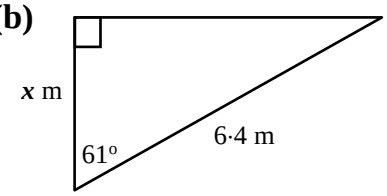


**3.** Use the **cosine** ratio to calculate the length of the side marked ***x*** in these right-angled triangles.

**(a)**




**(b)**

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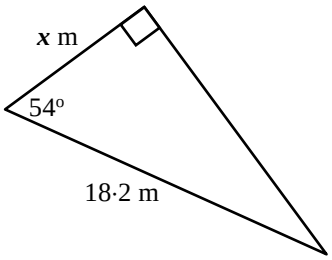


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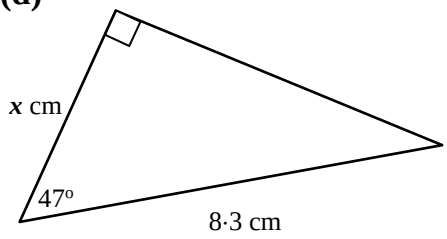


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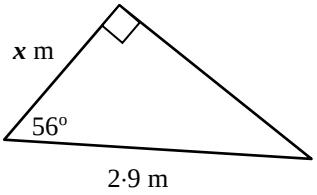
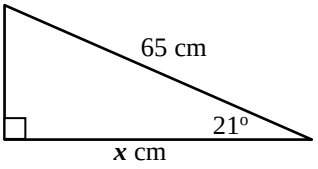
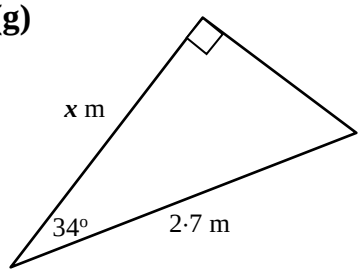



**(f)**




**(g)**

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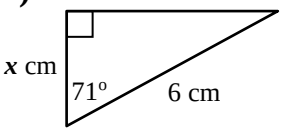


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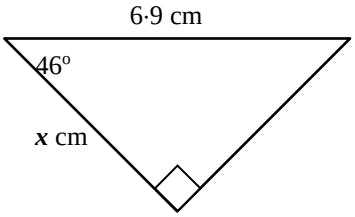


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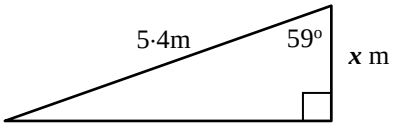


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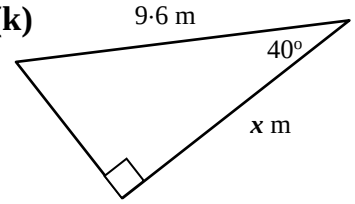


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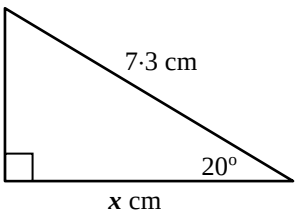
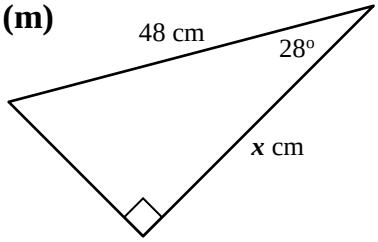



**(m)**

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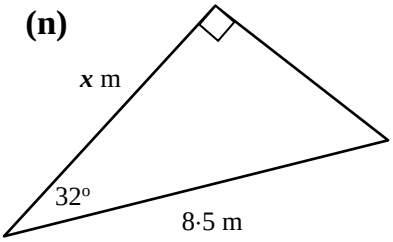


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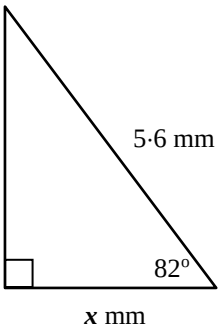
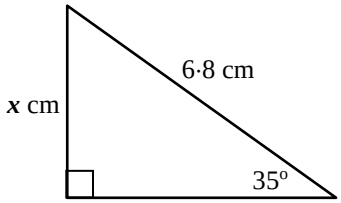
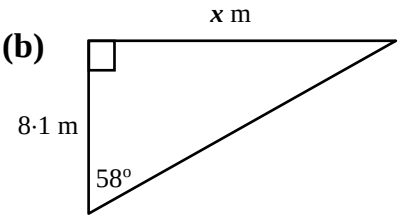


**4.** Calculate the length of the side marked ***x*** in these right-angled triangles. You will have to choose which ratio to use.

**(a)**




**(b)**

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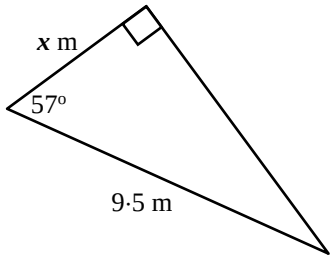


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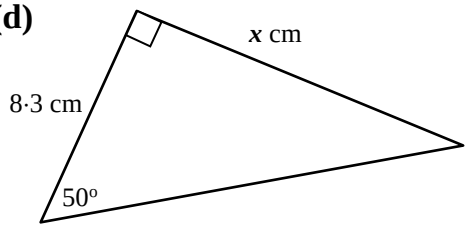


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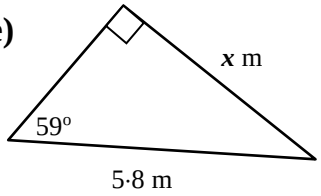


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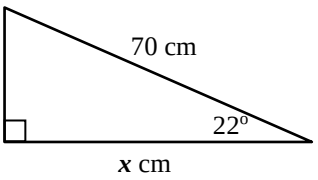


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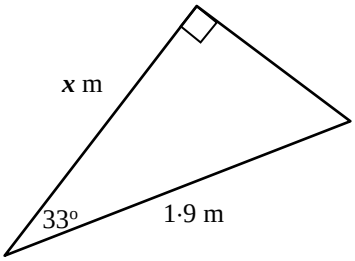
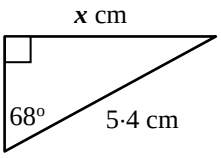
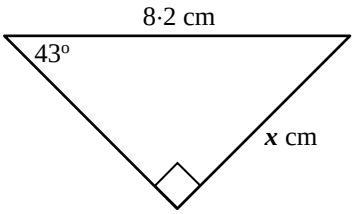



**(h)**




**(i)**

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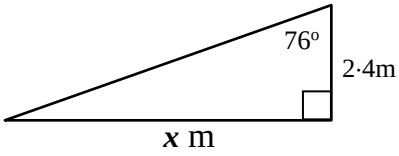


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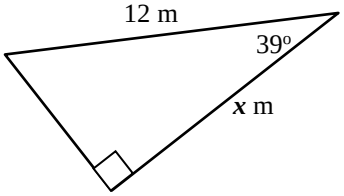


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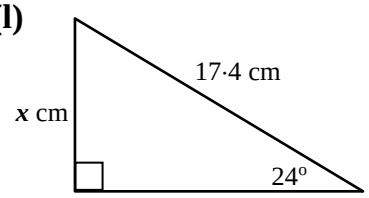
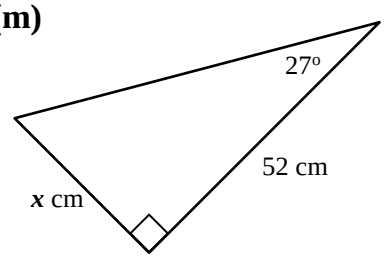
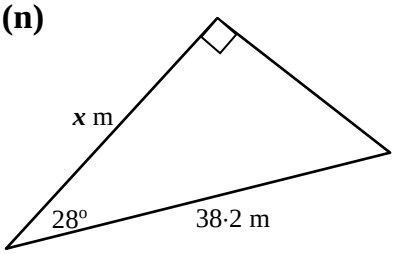


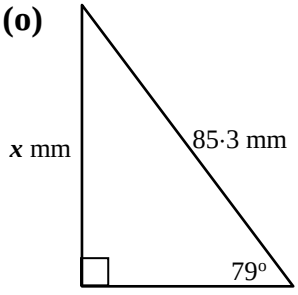

**(m)**




**(n)**




**(o)**

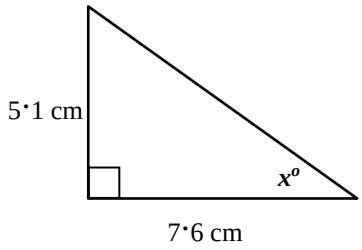


## Applying Trigonometric Skills to Right-angled Triangles

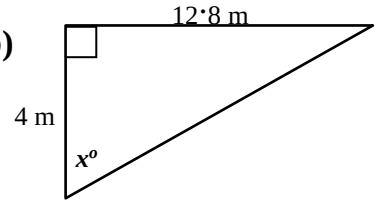
## Calculating an angle in a right-angled triangle

**1.** Use the **Tangent** ratio to calculate the size of the angle marked $x^o$ in these right-angled triangles.

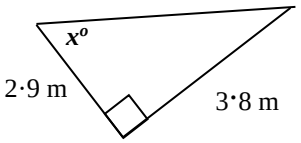
**(a)**



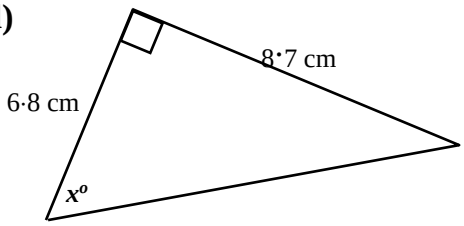

**(b)**



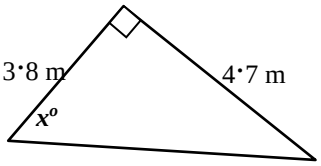

**(c)**



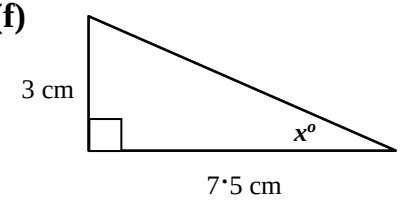

**(d)**



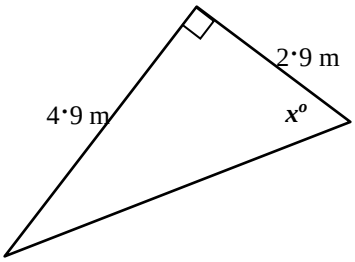

**(e)**



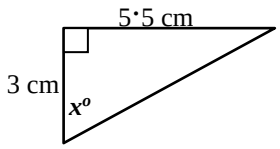

**(f)**



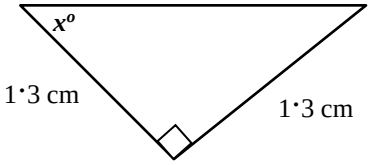

**(g)**




**(h)**




**(i)**

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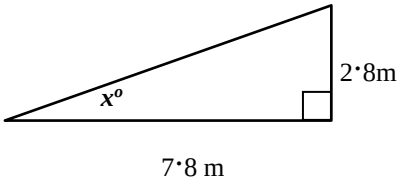
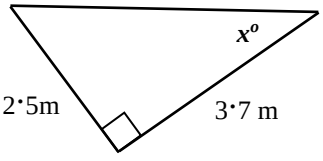
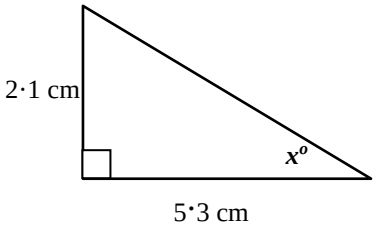


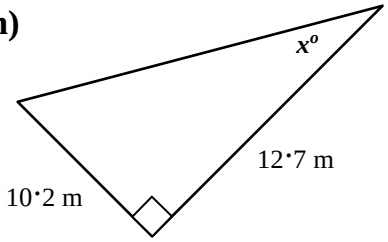

**(k)**




**(l)**




**(m)**

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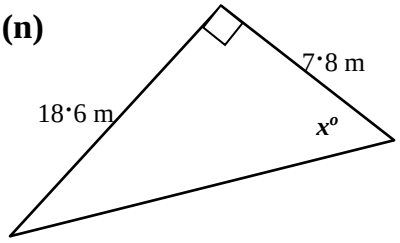
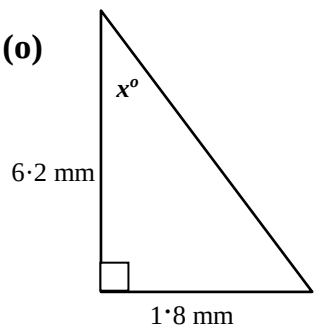
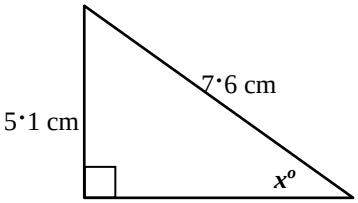



**(o)**

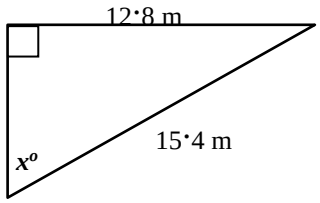


**2.** Use the **Sine** ratio to calculate the size of the angle marked $x^o$ in these right-angled triangles.

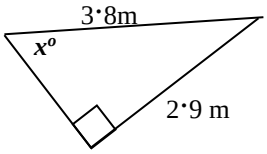
**(a)**



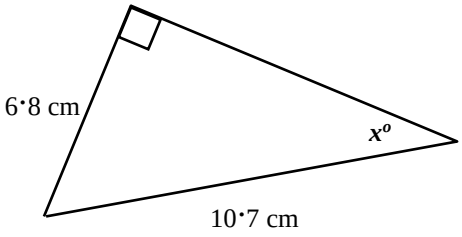

**(b)**



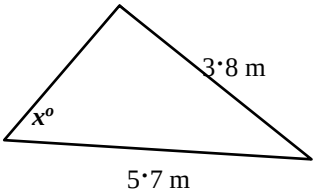

**(c)**



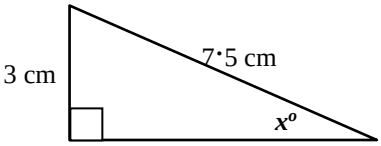

**(d)**



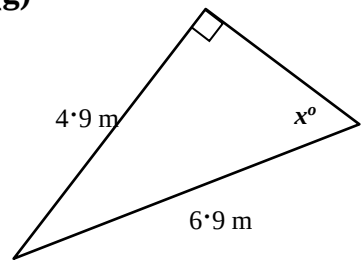

**(e)**



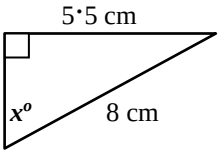

**(f)**



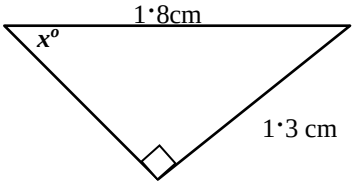

**(g)**




**(h)**




**(i)**

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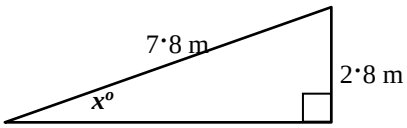
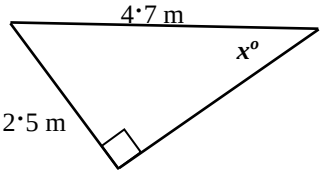
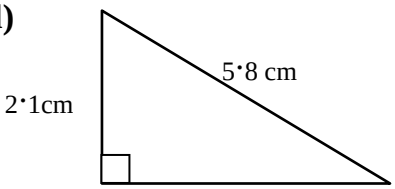


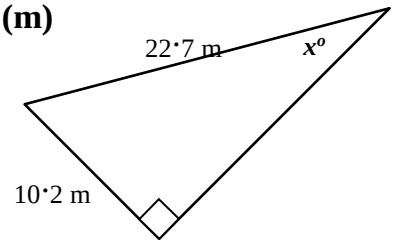

**(k)**



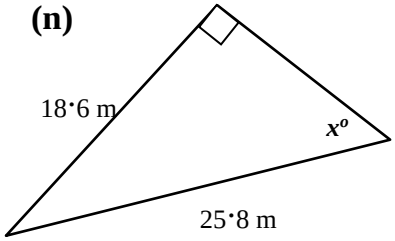

**(l)**



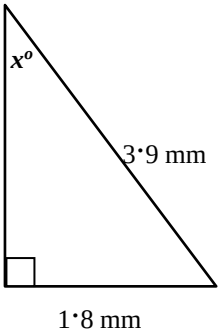

**(m)**




**(n)**

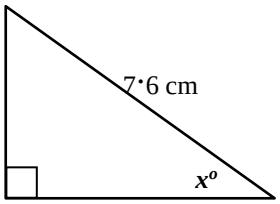



**(o)**

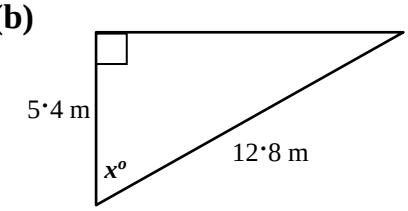


**3.** Use the **Cosine** ratio to calculate the size of the angle marked $x^o$ in these right-angled triangles.

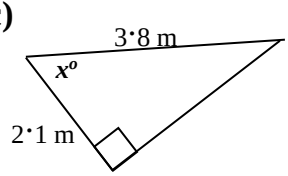
**(a)**



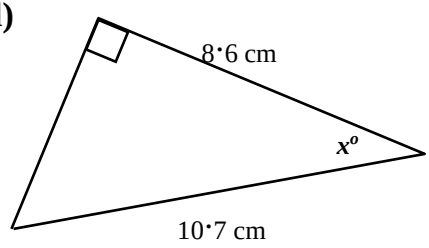

**(b)**



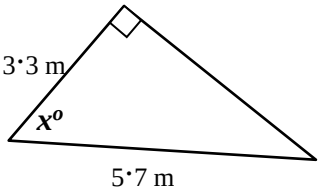

**(c)**



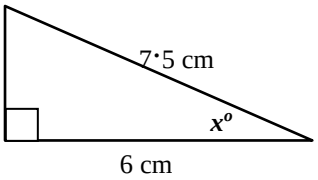

**(d)**



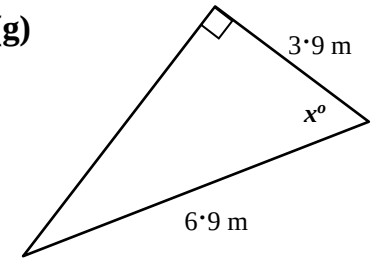

**(e)**



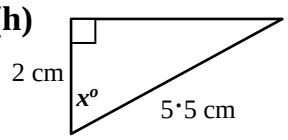

**(f)**



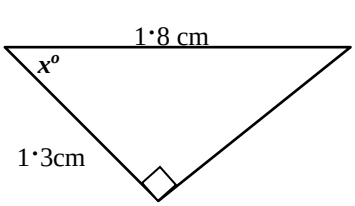

**(g)**



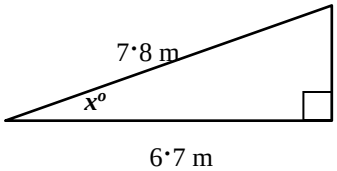

**(h)**



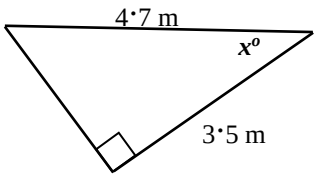

**(i)**



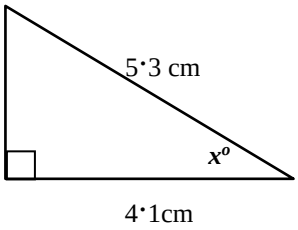

**(j)**



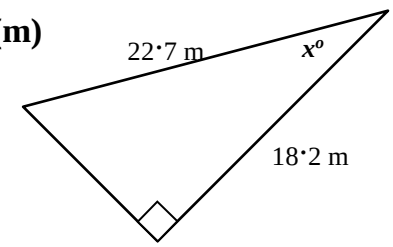

**(k)**



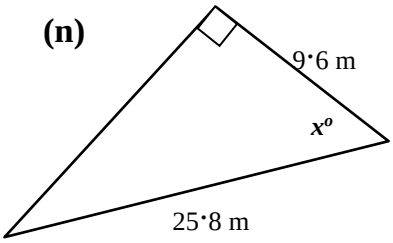

**(l)**



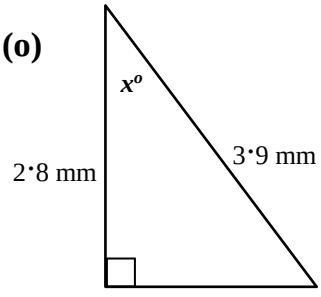

**(m)**




**(n)**

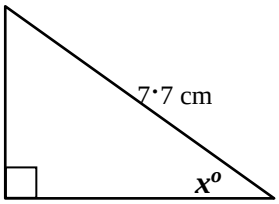



**(o)**

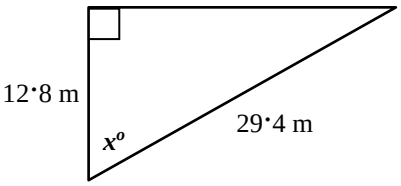


**4.** Calculate the size of the angle marked $x^0$ in these right-angled triangles. You will have to choose which ratio to use.

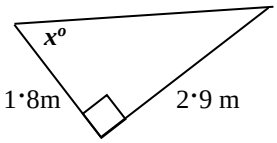
**(a)**



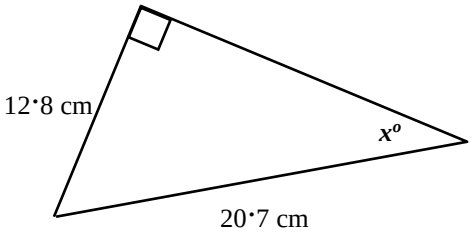

**(b)**



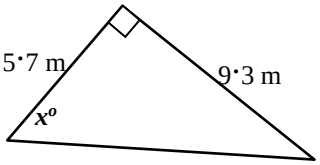

**(c)**



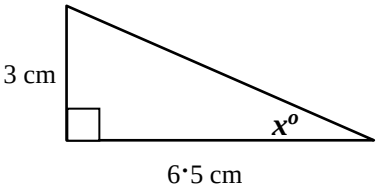

**(d)**



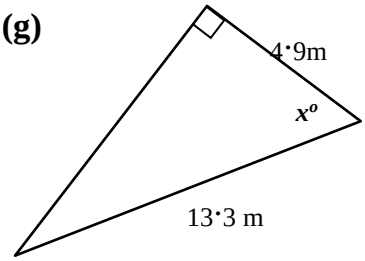

**(e)**



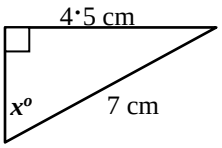

**(f)**



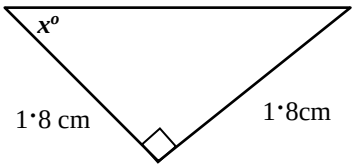

**(g)**




**(h)**




**(i)**

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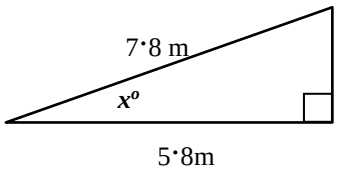
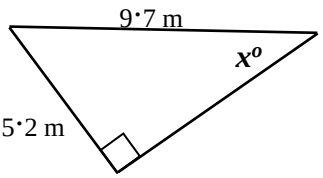
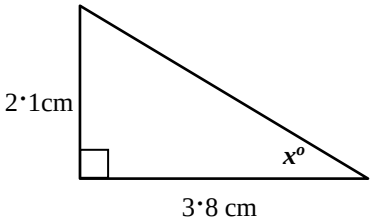



**(k)**




**(l)**

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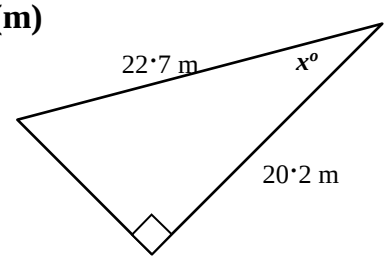
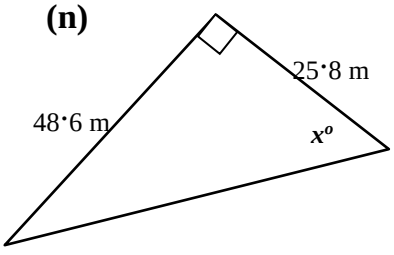
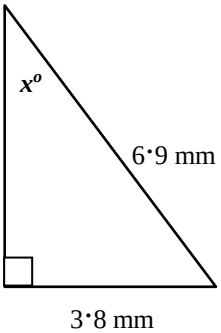



**(n)**




**(o)**



## Applying Trigonometric Skills to Right-angled Triangles

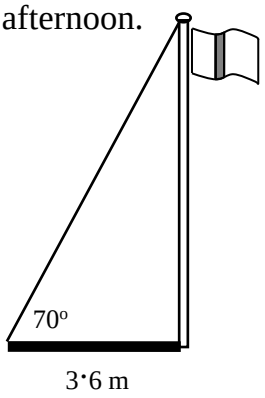
## Problem Solving Examples

**1**. This diagram shows the shadow cast by a flagpole early in the afternoon.

The shadow's length is 3·6 metres.

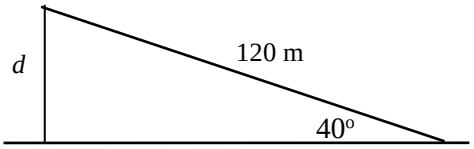
What is the height of the flagpole?

(Give your answer to 1 d.p.)



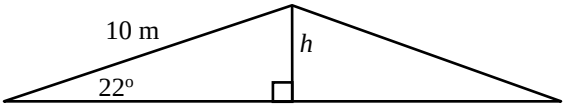

**2.** A 120 m long anchor holds a fishing boat in position. The line makes an angle of 40° with the sea floor.

How deep is the sea at this position?



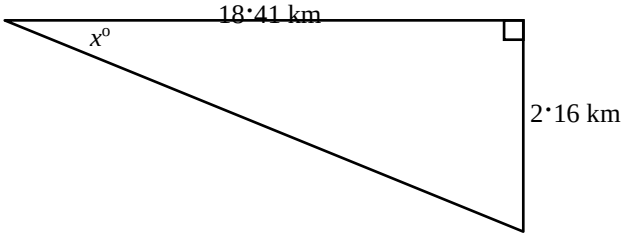

**3**. The diagram shows the symmetrical cross-section of a roof.

Find the height, *h*.

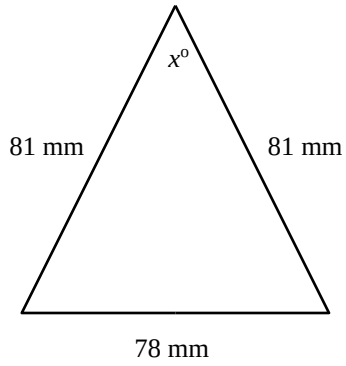



**4**. An aircraft making a steady descent decreases height by 2·16 km in 18·41 km.

What is the angle of descent, $x^o$?



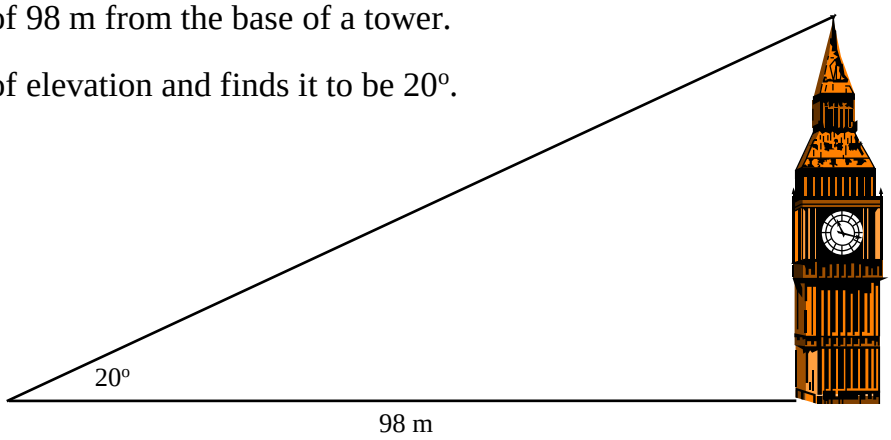
**5**. Find angle $x$ in this isosceles triangle



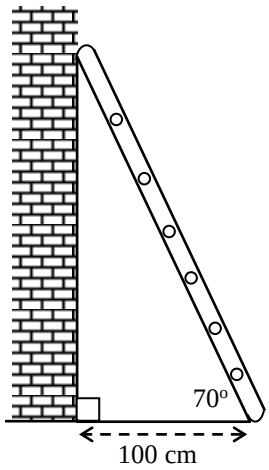

**6**. Peter stands a distance of 98 m from the base of a tower.

He measures the angle of elevation and finds it to be 20°.

How high is the tower?




**7**.



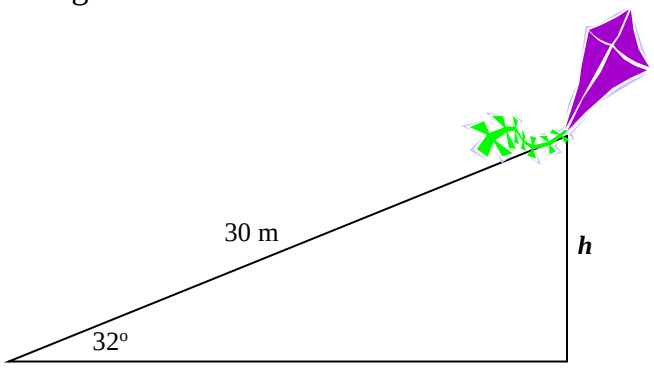

A ladder rests against a wall with its foot 100 cm from the wall.

How high up the wall does the ladder reach?

**8**. Eddie is flying his kite. The string is at an angle of 32° to the horizontal.

He lets out 30 metres of string.

How high is the kite above the ground?



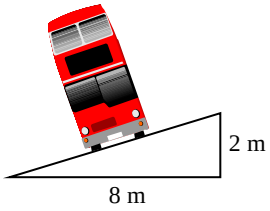
**9.** To test the stability of a bus a tilting platform is used.

It is known that a bus will topple if the angle between the platform and the ground is greater than 20°.

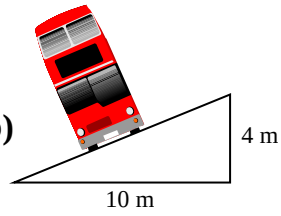
Which of the buses below would topple?

**Each answer must be accompanied with the appropriate working.**

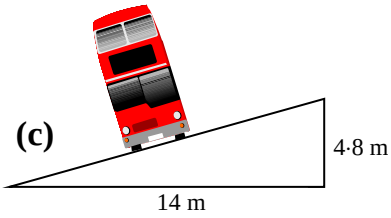
**(a)**



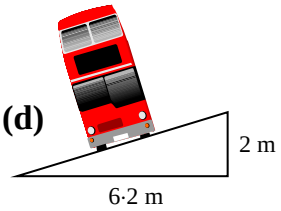

**(b)**



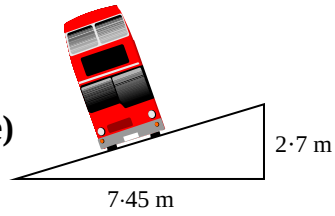

**(c)**



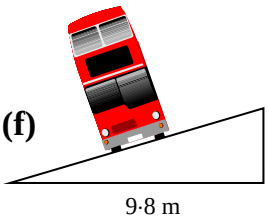

**(d)**



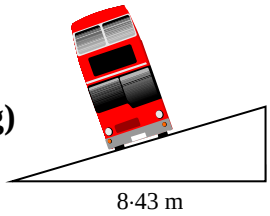

**(e)**



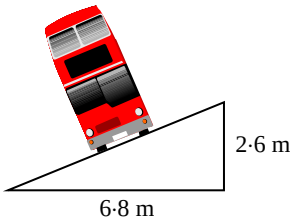

**(f)**



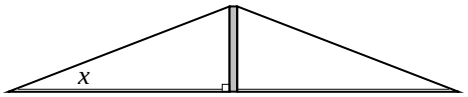

**(g)**




**(h)**



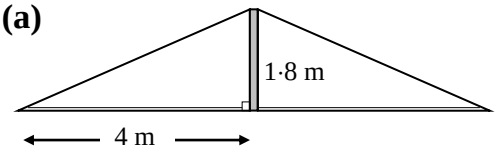

**10.** To comply with building regulations a roof must have an angle of between 22° and 28° to the horizontal (see diagram opposite).



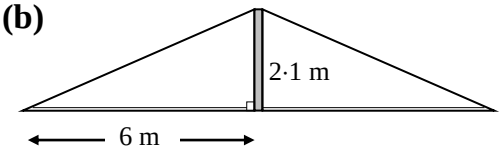

*x* must lie between 22° and 28°

Which of the roofs below comply, and which do not comply with building regulations?

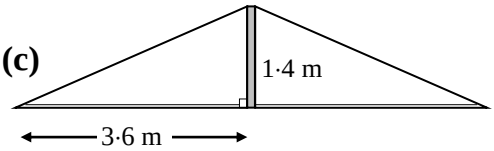
**(a)**



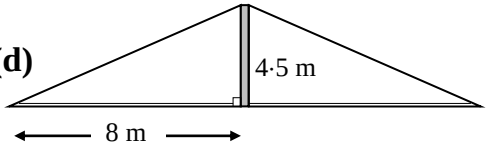

**(b)**



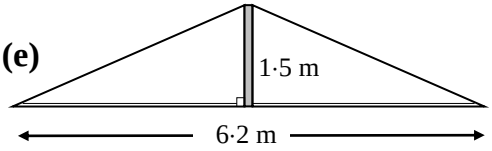

**(c)**



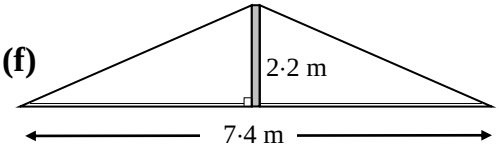

**(d)**



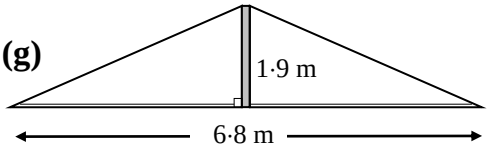

**(e)**



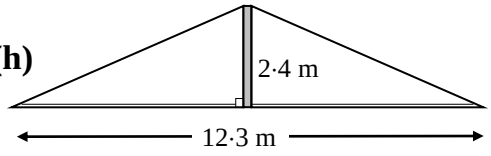

**(f)**




**(g)**




**(h)**

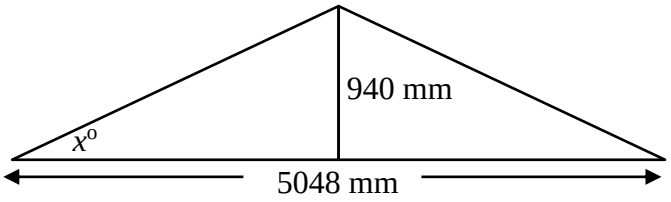


## Applying Trigonometric Skills to Right-angled Triangles

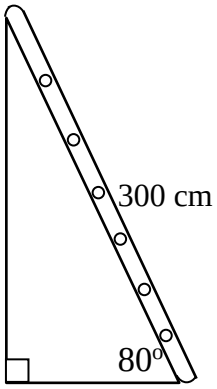
## EXAM QUESTIONS

**1**. A manufacturer of concrete roof tiles states that to be suitable for concrete tiles the angle of a roof (pitch) must be greater than 21°.

This roof is symmetrical. Is this roof suitable for concrete tiles?




**2.**

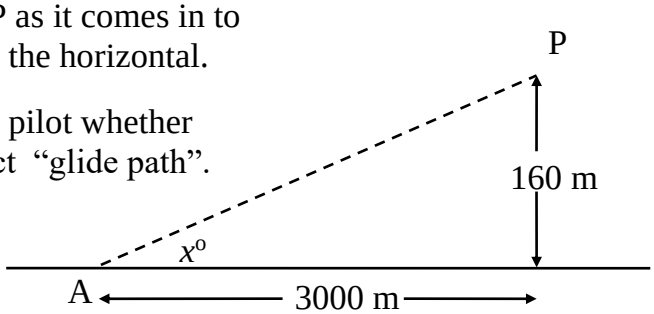



A ladder 300 cm long rests against a wall at an angle of 80 degrees.

How high up the wall does the ladder reach?

**3**. The angle of approach, $x^o$, of a plane P as it comes in to land should be between 3° and 5° with the horizontal.

The air traffic controller has to tell the pilot whether he is too high, too low or on the correct "glide path".

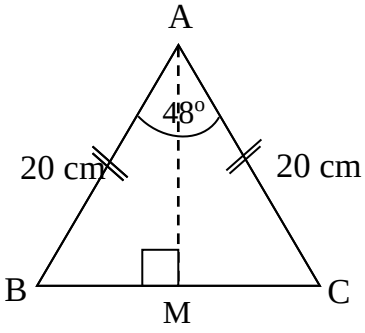



An incoming plane is 3000 m away from its landing point A and is at a height of 160 m as shown in the diagram.

Is the plane too high, too low or on the correct "glide path"?

**4**. In triangle ABC, angle BAC is 48°.

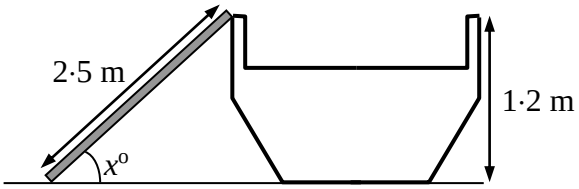
Calculate the length of BC.



**5**. The rim of a rubbish skip is 1·2 m from the ground.

A workman places a plank 2·5 m long so that it just reaches the rim.

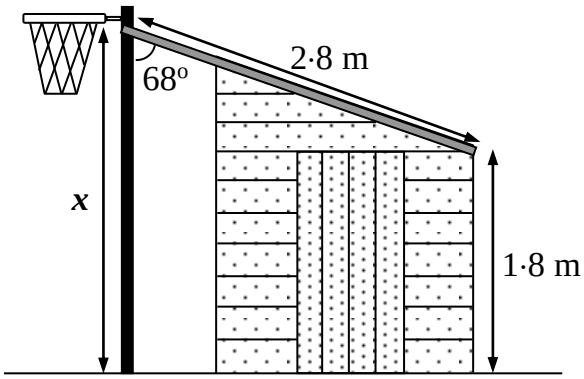
What angle, $x^o$, will the plank make with the ground?




**6.** Craig has put a basketball set on pole in his garden. To secure the pole he intends to fix it with a baton nailed to his garden shed.

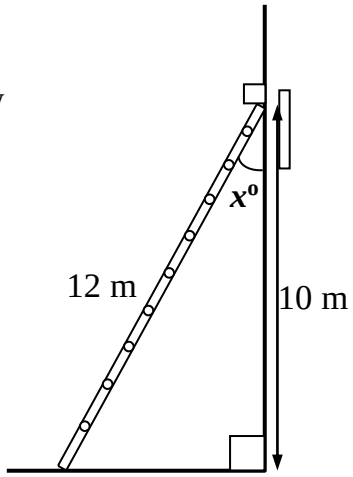
The baton makes an angle of 68° with the pole and is 2·8 m long.

How far up the pole will the baton reach, ***x***?

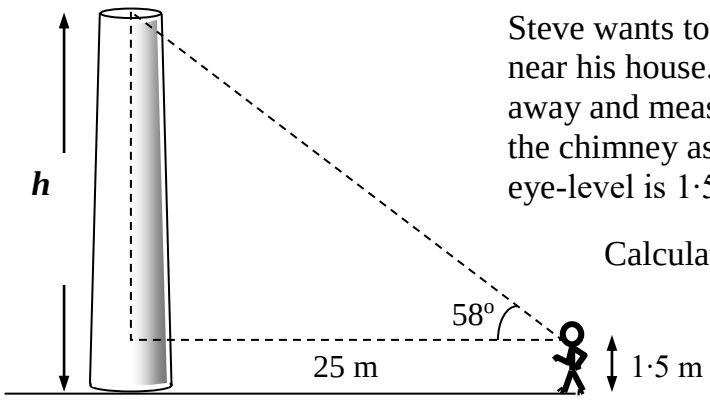



**7**. A firefighter has a 12 metre ladder and needs to reach a window 10 metres from the ground.

What angle, $x^o$, will the ladder make with the building?




**8**.

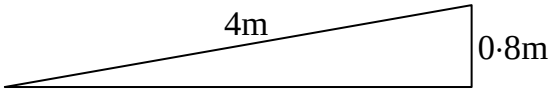



Steve wants to find the height of a chimney near his house. He stands at a point 25 m away and measures the angle to the top of the chimney as 58°.The height to Steve's eye-level is 1·5 m.

Calculate the height, ***h***, of the chimney.

**9.** Mr and Mrs Hamilton are building a ramp to allow their disabled daughter easier access to the house.

The ramp has to rise by 0·8m and has to be 4 metres long.



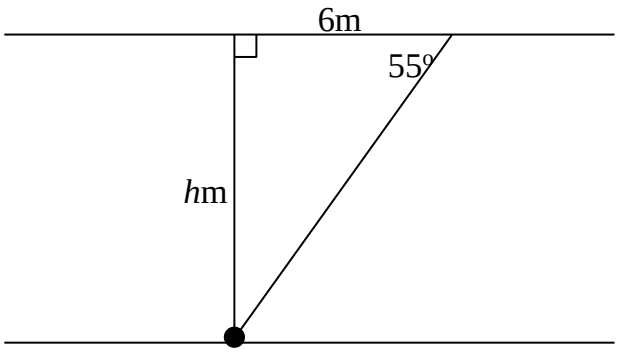

Planning regulations state that the angle between the ground and the ramp has to be between 10º and 12º.

Would Mr and Mrs Hamilton's ramp meet these conditions?

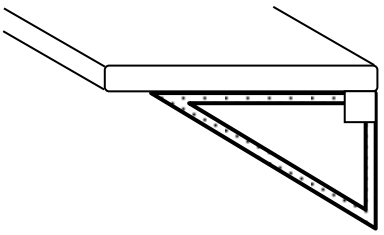
Show all working and give a reason for your answer.

**10.** Two spotlights on a stage are set 6 metres apart. The beams are set so that the light from them hits one particular spot on the stage. One light is directly above the spot and the other beam of light is at an angle of 55º to the horizontal. The diagram illustrates the situation.

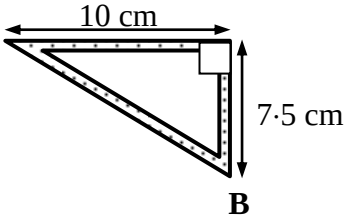
Calculate how far, *h* m, above the stage the lights are set.




**11**. A triangular bracket is designed to support a shelf.



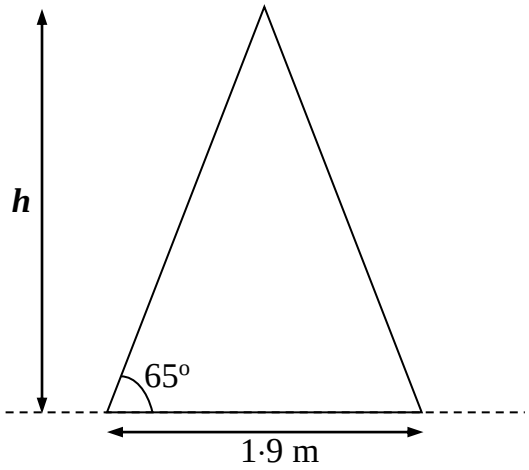
Its length is 10 cm and its height is 7·5 cm.

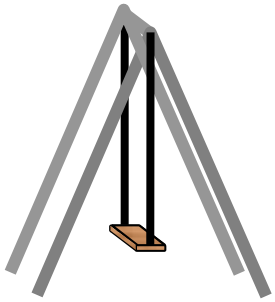



**B**

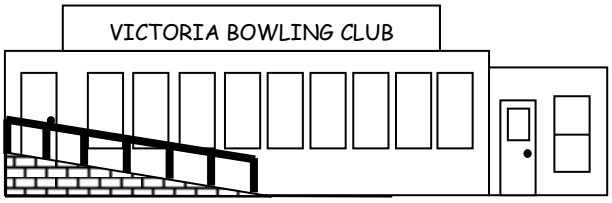
Calculate the angle at the base of the bracket, angle B.

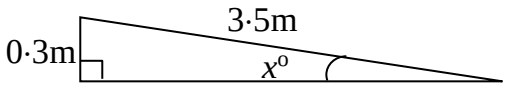
**12**. The frame of a child's swing is in the shape of an isosceles triangle.



**13.** A ramp has been constructed at a bowling club. It is 3·5metres long and rises through 0·3metres.

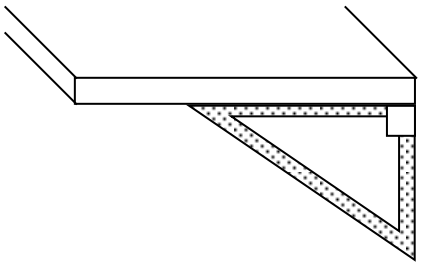


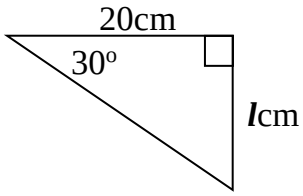




Calculate the angle, $x^o$, that the ramp makes with the horizontal.

**14.** A triangular bracket is designed to support a shelf.

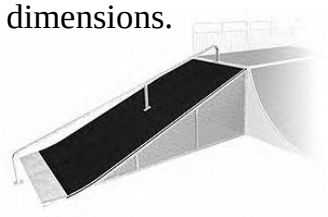
Its width is 20cm and it makes an angle of 30° with the horizontal shelf.

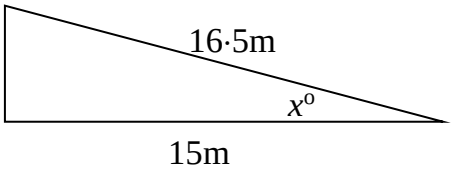





Calculate the length, ***l***cm, of the bracket.

**15.** A skateboard ramp has been designed to have the following dimensions.

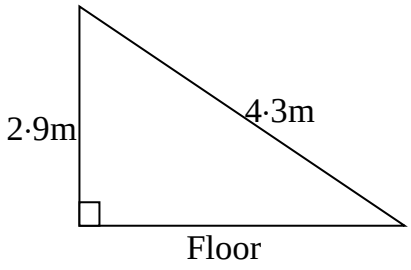





The ramp can only be used in competitions if the angle, $x^o$, is between 24 and 26 degrees.

Can this ramp be used in a competition? You must show all working and give a reason for your answer.

**16.** I have just had a new staircase fitted in my house. It rises by a height of 2·9m and is 4·3m long.



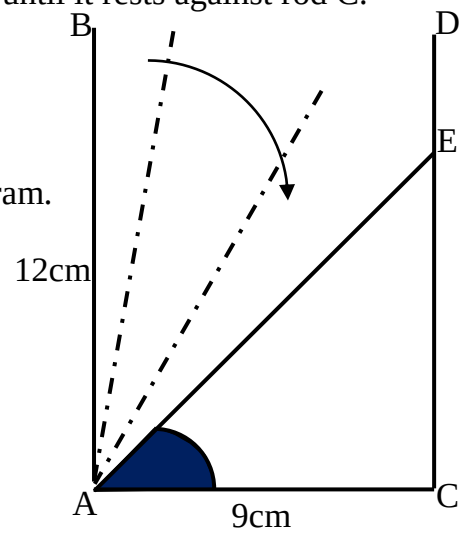

Find the angle, $x^o$, which the staircase makes with the floor.

**17.** In a switch mechanism lever AB rotates round A until it rests against rod C.

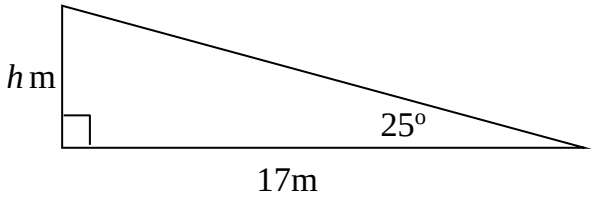
Point B touches rod CD at E.

AB = 12cm and AC = 9cm as shown in the diagram.

Calculate the size of the shaded angle when the switch is closed.



**18.** A skateboard ramp has been designed to have the dimensions shown in the diagram.



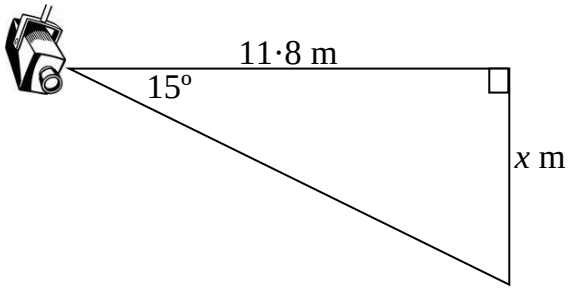

**(a)** Calculate the height, *h* m, of the ramp.

Safety regulations state that the angle that the ramp makes with the ground should be a **maximum** of 23°.

**(b)** Calculate how much the height of the ramp would have to be lowered for it to be considered safe. Give your answer in centimetres.

**19.** A security camera is secured to a beam on a ceiling in a warehouse. The length of the warehouse is 11·8 metres and the angle of depression of the camera is 15°.

Calculare the height of the warehouse.

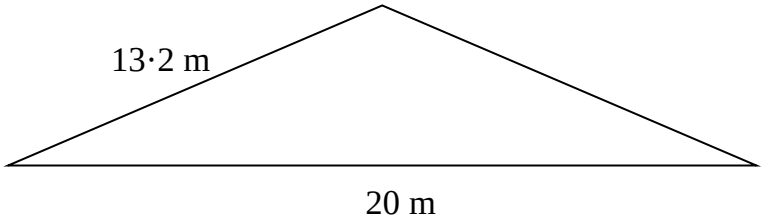



**20.** A builder wants to measure the angle made between the roof of the building and the attic floor below.

The length of the attic floor is 20 metres long and the length of the sloping roof is 13·2 metres.

For the roof to meet building regulations the angle between the floor and the roof must measure between 38° and 40°.

Does the roof meet regulations? ***Give a reason for your answer.***



## Applying Trigonometric Skills to Right-angled Triangles

## Calculating a side in a right-angled triangle

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **1**. | **(a)** | 1·9cm | **(b)** | 6m | **(c)** | 17m | | |
| | **(d)** | 3·9cm | **(e)** | 4·6m | **(f)** | 13·7cm | | |
| | **(g)** | 5m | **(h)** | 9·2cm | **(i)** | 4·9cm | | |
| | **(j)** | 5·4m | **(k)** | 3·1m | **(l)** | 1·3cm | | |
| | **(m)** | 17·7cm | | **(e)** 5·8m | | **(o)** | 17·7mm | |
| **2**. | **(a)** | 3cm | **(b)** | 5·7m | **(c)** | 14·5m | | |
| | **(d)** | 6cm | **(e)** | 2·4m | **(f)** | 24·3cm | | |
| | **(g)** | 1·5m | **(h)** | 5·7cm | **(i)** | 4·9cm | | |
| | **(j)** | 4·6m | **(k)** | 6·3m | **(l)** | 2·4cm | | |
| | **(m)** | 23·3cm | **(n)** | 4·6m | **(o)** | 5·5mm | | |
| **3**. | **(a)** | 3·7cm | **(b)** | 3·1m | **(c)** | 10·7m | | |
| | **(d)** | 5·7cm | **(e)** | 1·6m | **(f)** | 60·7cm | | |
| | **(g)** | 2·2m | **(h)** | 2cm | **(i)** | 4·8cm | | |
| | **(j)** | 2·8m | **(k)** | 7·4m | **(l)** | 6·9cm | | |
| | **(m)** | 42·4cm | **(n)** | 7·2m | **(o)** | 0·8mm | | |
| **4.** | **(a)** | 3·9cm | **(b)** | 13m | **(c)** | 5·2m | | |
| | **(d)** | 9·9cm | **(e)** | 5m | **(f)** | 64·9cm | | |
| | **(g)** | 1·6m | **(h)** | 5cm | **(i)** | 5·6cm | | |
| | **(j)** | 9·6m | **(k)** | 9·3m | **(l)** | 7·1cm | | |
| | **(m)** | 26·5cm | **(n)** | 33·7m | **(o)** | 83·7mm | | |

## Applying Trigonometric Skills to Right-angled Triangles

## Calculating an angle in a right-angled triangle

| | | | | | | |
|---|---|---|---|---|---|---|
| **1**. | **(a)** | $33{\cdot}9^{o}$ | **(b)** | $72{\cdot}6^{o}$ | **(c)** | $52{\cdot}7^{o}$ |
| | **(d)** | $52^{o}$ | **(e)** | $51^{o}$ | **(f)** | $21{\cdot}8^{o}$ |
| | **(g)** | $59{\cdot}4^{o}$ | **(h)** | $61{\cdot}4^{o}$ | **(j)** | $45^{o}$ |
| | **(j)** | $19{\cdot}7^{o}$ | **(k)** | $34^{o}$ | **(l)** | $21{\cdot}6^{o}$ |
| | **(m)** | $38{\cdot}8^{o}$ | **(n)** | $67{\cdot}2^{o}$ | **(o)** | $16{\cdot}2^{o}$ |
| **2**. | **(a)** | $42{\cdot}1^{o}$ | **(b)** | $56{\cdot}2^{o}$ | **(c)** | $49{\cdot}7^{o}$ |
| | **(d)** | $39{\cdot}5^{o}$ | **(e)** | $41{\cdot}8^{o}$ | **(f)** | $23{\cdot}6^{o}$ |
| | **(g)** | $45{\cdot}2^{o}$ | **(h)** | $43{\cdot}4^{o}$ | **(i)** | $46{\cdot}2^{o}$ |
| | **(j)** | $21^{o}$ | **(k)** | $32{\cdot}1^{o}$ | **(l)** | $21{\cdot}2^{o}$ |
| | **(m)** | $26{\cdot}7^{o}$ | **(n)** | $46{\cdot}1^{o}$ | **(o)** | $27{\cdot}5^{o}$ |
| **3**. | **(a)** | $47{\cdot}9^{o}$ | **(b)** | $65^{o}$ | **(c)** | $56{\cdot}5^{o}$ |
| | **(d)** | $36{\cdot}5^{o}$ | **(e)** | $54{\cdot}6^{o}$ | **(f)** | $36{\cdot}9^{o}$ |
| | **(g)** | $55{\cdot}6^{o}$ | **(h)** | $68{\cdot}7^{o}$ | **(i)** | $43{\cdot}8^{o}$ |
| | **(j)** | $30{\cdot}8^{o}$ | **(k)** | $41{\cdot}9^{o}$ | **(l)** | $39{\cdot}3^{o}$ |
| | **(m)** | $36{\cdot}7^{o}$ | **(n)** | $68{\cdot}2^{o}$ | **(o)** | $44{\cdot}1^{o}$ |
| **4**. | **(a)** | $47{\cdot}5^{o}$ | **(b)** | $64{\cdot}2^{o}$ | **(c)** | $58{\cdot}1^{o}$ |
| | **(d)** | $38{\cdot}2^{o}$ | **(e)** | $58{\cdot}5^{o}$ | **(f)** | $24{\cdot}8^{o}$ |
| | **(g)** | $68{\cdot}4^{o}$ | **(h)** | $40^{o}$ | **(i)** | $45^{o}$ |
| | **(j)** | $42^{o}$ | **(k)** | $32{\cdot}4^{o}$ | **(l)** | $28{\cdot}9^{o}$ |
| | **(m)** | $27{\cdot}1^{o}$ | **(n)** | $62^{o}$ | **(o)** | $33{\cdot}4^{o}$ |

## Applying Trigonometric Skills to Right-angled Triangles

## Problem Solving Questions

**1.** 9·9 m **2.** 77·1 m **3.** 3·7 m **4.** 6·7$^o$

**5.** 57·6$^o$ **6.** 35·7$^o$ **7.** 275 cm **8.** 15·9m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **9.** | **(a)** | 14·0$^o$ | **N** | **(b)** | 21·8$^o$ | **Y** | **(c)** | 18·9$^o$ | **N** | **(d)** | 17·9$^o$ | **N** |
| | **(e)** | 19·9$^o$ | **N** | **(f)** | 20·2$^o$ | **Y** | **(g)** | 19·6$^o$ | **N** | **(h)** | 20·9$^o$ | **Y** |
| **10.** | **(a)** | 24·2$^o$ | **Y** | **(b)** | 19·3$^o$ | **N** | **(c)** | 21·3$^o$ | **N** | **(d)** | 29·4$^o$ | **N** |
| | **(e)** | 25·8$^o$ | **Y** | **(f)** | 30·7$^o$ | **N** | **(g)** | 29·2$^o$ | **N** | **(h)** | 21·3$^o$ | **N** |

## Applying Trigonometric Skills to Right-angled Triangles

## EXAM QUESTIONS

**1.** No since 20·4$^o$ < 21$^o$ **2.** 295cm or 2·95maA

**3.** Correct since 3$^o$ < 3·05$^o$ < 5$^o$ **4.** 16·2cm or 16·3cm depending on rounding

**5.** 28·7$^o$ **6.** 2·85m

**7.** 33 ·6$^o$ **8.** 41·5m

**9.** Yes, since 10$^o$ < 11·5$^o$ < 12$^o$ **10.** 8·57m

**11.** 53·1$^o$ **12.** 2·04m

**13.** 4·9$^o$ **14.** 11·5cm

**15.** OK since 24$^o$ < 24·6$^o$ < 26$^o$ **16.** 42$^o$

**17.** 41·4$^o$ **18.** **(a)** 7·9m **(b)** 70cm or 71cm [rounding]

**19.** 3·16m **20.** No since 40·7$^o$ > 40$^o$