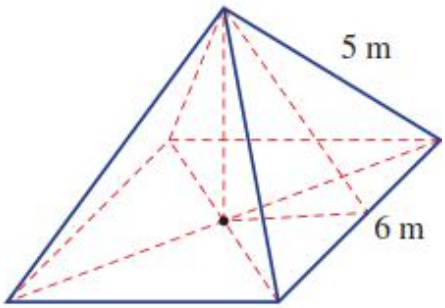
CTJan27 Online Trigonometry - Applications in Three Dimensions

Although a right-angled triangle is a two-dimensional shape, it can also be used to solve problems in three dimensions. Being able to visualise right-angled triangles included in three-dimensional diagrams is an important part of the process of finding angles and lengths associated with three-dimensional objects.

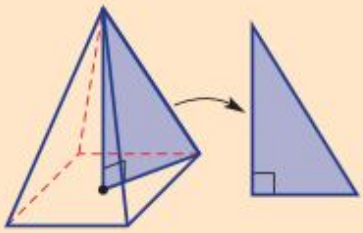
Let's start: How many right-angled triangles?

A right square-based pyramid has the apex above the centre of the base. In this example, the base length is 6 m and slant height is 5 m. Other important lines are dashed.



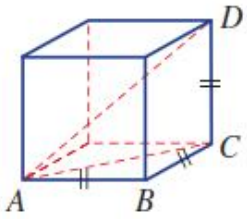
- Using the given dashed lines and the edges of the pyramid, how many different right-angled triangles can you draw?
- Is it possible to determine the exact side lengths of all your right-angled triangles?
- Is it possible to determine all the angles inside all your right-angled triangles?

■ Using trigonometry to solve problems in three dimensions involves:
- visualising and drawing any relevant two-dimensional triangles
- using trigonometric ratios to find unknowns
- relating answers from two-dimensional diagrams to the original three-dimensional object.



1. (1 point)

The cube shown here has side length 2 m.



a Draw the right-angled triangle ABC and find and label all the side lengths. Pythagoras' theorem can be used. Answer using exact values (e.g. $\sqrt{5}$).

b Draw the right-angled triangle ACD and find and label all the side lengths. Pythagoras' theorem can be used. Answer using exact values.

c Use trigonometry to find $\angle DAC$, correct to one decimal place.

d Find the size of $\angle CAB$.

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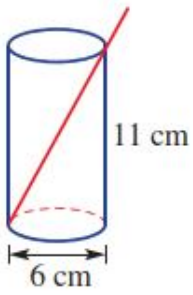
2. (1 point)

Find the angle of elevation this red drinking straw makes with the base of the can, which has diameter 6 cm and height 11 cm. Round your answer to one decimal place.



A vertical mast is supported at the top by two cables reaching from two points, A and B. The cable reaching from point A is 43 metres long and is at an angle of 61° to the horizontal. Point B is 37 metres from the base of the mast.

a Find the height of the mast, correct to three decimal places.

b Find the angle to the horizontal of the cable reaching from point B, to two decimal places.

3. a. (1 point)

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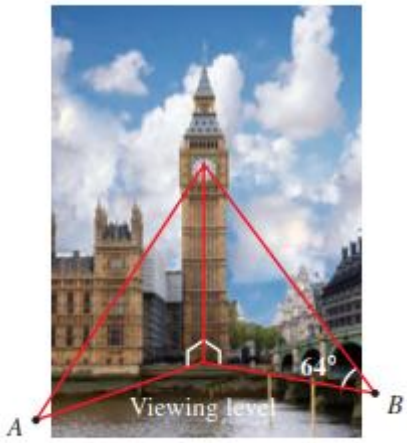
4. b. (1 point)

Viewing points A and B are at a horizontal distance from a clock tower of 36 metres and 28 metres, respectively. The viewing angle to the clockface at point B is 64°.

a Find the height of the clockface above the viewing level, to three decimal places.

b Find the viewing angle to the clockface at point A, to two decimal places.



5. a. (1 point)

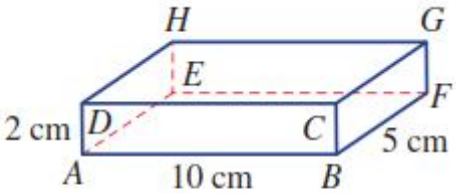
6. b. (1 point)

A rectangular prism, $ABCDEFGH$, is 5 cm wide, 10 cm long and 2 cm high.

a By drawing the triangle ABF find, to two decimal places:

i $\angle BAF$ **ii** AF

b By drawing the triangle AGF, find $\angle GAF$, to two decimal places.



7. a, i (1 point)

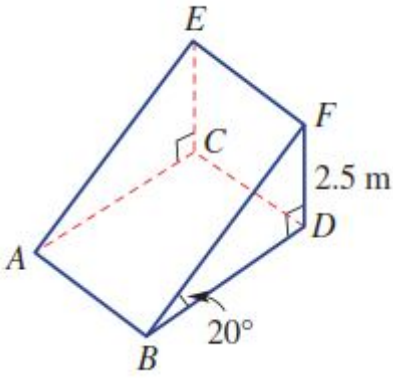
8. a, ii (1 point)

9. b. (1 point)

A ramp, $ABCDEF$, rests at an angle of 20° to the horizontal and the highest point on the ramp is 2.5 metres above the ground, as shown. Give your answers to two decimal places in the following questions.

a Find the length of the ramp BF.

b Find the length of the horizontal BD.



10. a. (1 point)

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11. b. (1 point)

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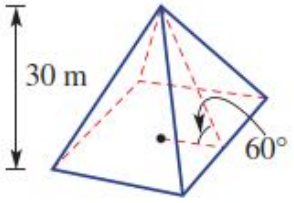
12. (1 point)

The triangular faces of a right square-based pyramid are at an angle of 60° to the base. The height of the pyramid is 30 m. Find the perimeter of the base of the pyramid, correct to one decimal place.

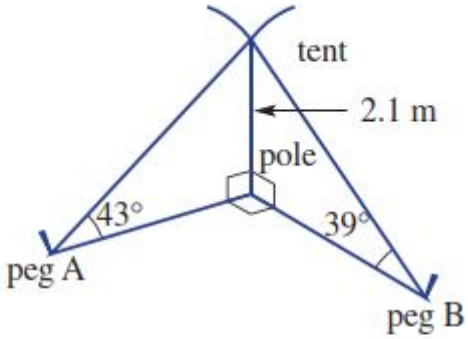


A tent pole 2.1 metres tall is secured by ropes in two directions. The ropes are held by pegs A and B at angles of 43° and 39°, respectively, from the horizontal. The line from the base of the pole to peg A is at right angles to the line from the base of the pole to peg B. Round your answers to two decimal places in these questions.

a Find the distance from the base of the tent pole to:
i peg A **ii** peg B

b Find the angle at peg B formed by peg A, peg B and the base of the pole.

c Find the distance between peg A and peg B.



13. a. i (1 point)

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14. a. ii (1 point)

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15. b. (1 point)

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16. c. (1 point)

The communities of Wood Town and Green Village live in a valley. Communication between the two communities is enhanced by a repeater station on the summit of a nearby mountain.

It is known that the angles of depression from the repeater station to Wood Town and Green Village are 44.6° and 58.2°, respectively. Also, the horizontal distances from the repeater to Wood Town and Green Village are 1.35 km and 1.04 km, respectively.

a Find the vertical height, to the nearest metre, between the repeater station and:
i Wood Town **ii** Green Village

b Find the difference in height between the two communities, to the nearest metre.

17. a.i (1 point)

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18. a.ii (1 point)

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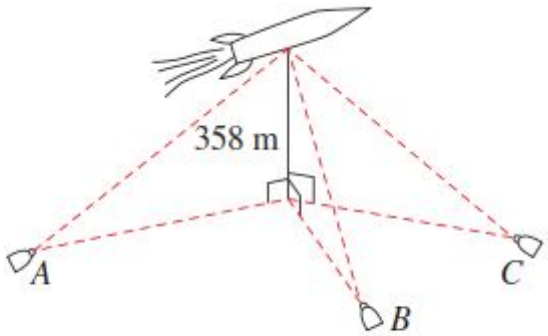
19. b. (1 point)

Three cameras operated at ground level view a rocket being launched into space.
At 5 seconds immediately after launch, the rocket is 358 m above ground level and the three cameras, A, B and C, are positioned at an angle of 28°, 32° and 36°, respectively, to the horizontal.
At the 5 second mark, find:



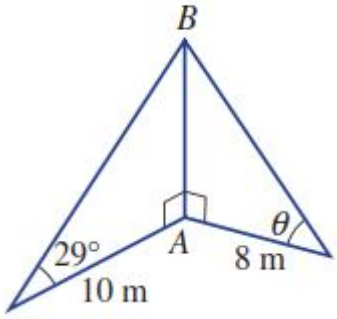
a which camera is closest to the rocket
b the distance between the rocket and the closest camera, to the nearest centimetre.

20. a. (1 point)

- Camera A
- Camera B
- Camera C

21. b. (1 point)

It is important to use a high degree of accuracy for calculations that involve multiple parts.
For this 3D diagram complete these steps.



a Find AB, correct to one decimal place.

b Use your answer from part **a** to find θ, correct to one decimal place.

c Now recalculate θ using a more accurate value for AB. Round θ to one decimal place.

d What is the difference between the answers for parts **b** and **c**?

22. a. (1 point)

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23. b. (1 point)

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24. c. (1 point)

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25. d. (1 point)
