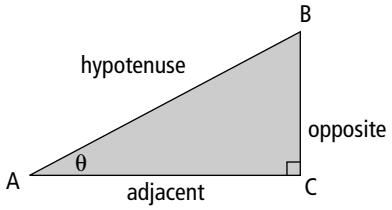
Chapter 3 Right Triangle Trigonometry

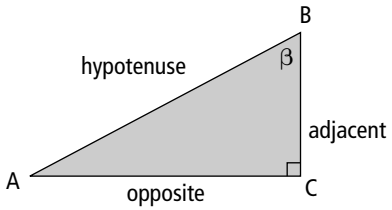
3.1 The Tangent Ratio

KEY IDEAS

- In similar triangles, corresponding angles are equal, and corresponding sides are in proportion. Therefore, the ratios of the lengths of corresponding sides are equal.

- The sides of a right triangle are labelled according to a reference angle.





- The tangent ratio compares the length of the side opposite the reference angle to the length of the side adjacent to the angle in a right triangle. For the reference angle θ in the upper triangle,

$$\tan\theta = \frac{\text{length of side opposite } \theta}{\text{length of side adjacent to } \theta}$$

For the reference angle β in the lower triangle,

$$\tan\beta = \frac{\text{length of side opposite } \beta}{\text{length of side adjacent to } \beta}$$

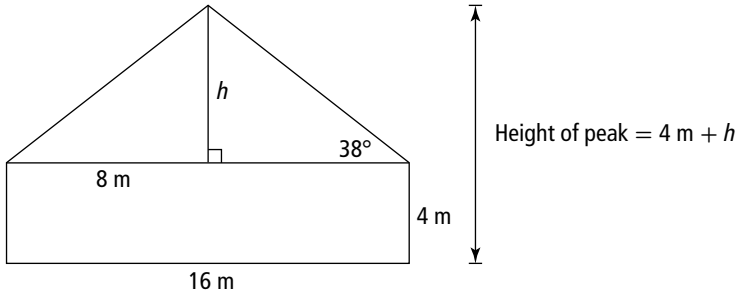
- You can use the tangent ratio to
  - determine the measure of one of the acute angles when the lengths of both legs in a right triangle are known
  - determine a side length if the measure of one acute angle and the length of one leg of a right triangle are known

Example

A housing contractor is required to build a roof on a house with a 38° slope from the horizontal. Additionally, the peak of the roof is to align with the centre of the end walls. The house is 16 m wide and has that are 4 m high. To the nearest tenth of a metre, how high will the peak be above the ground once the house is completed?

Solution

Organize the information and sketch a diagram to illustrate the problem.



Since the peak must be in the centre of a wall that is 16 m wide, it means that any point directly below the peak is 8 m from either side. Create a right triangle (two right triangles, actually) using the top of the wall, the height of the roof, and the roofline.

Let h represent the height, in metres, of the roof above the top of the wall.
Identify the sides in terms of the given angle of 38°: opposite = h and adjacent = 8 m.
Apply the tangent ratio using $\theta = 38°$:

$$\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$

$$\tan 38° = \frac{h}{8}$$

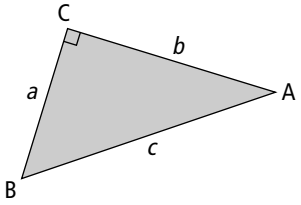
Isolate the value h and solve. (Remember to set your calculator to degrees.)

$$8(\tan 38°) = h$$
$$8(0.7812) = h$$
$$6.2496 = h$$

The height, h, of the roof above the wall is 6.25 m, to the nearest tenth of a metre.
Therefore, the height of the peak above the ground once the house is completed is 6.25 m + 4 m (height of wall) = 10.25 m.

A Practise

1. For $\angle$B in right $\triangle$ABC, identify



a) the hypotenuse

b) the adjacent side

c) the opposite side

2. Refer to right $\triangle$ABC in question 1.

a) State the tangent ratio of $\angle$A.

b) State the tangent ratio of $\angle$B.

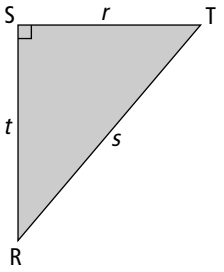
3. Refer to right $\triangle$ABC in question 1.

a) If $a = 10$ cm and $b = 12$ cm, what is the value of tan A?

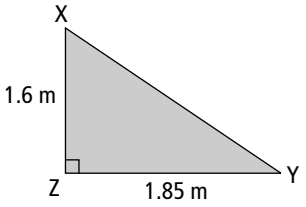
b) If $a = 1.9$ m and $b = 2.4$ m, what is the value of tan B?

c) If $\tan A = \frac{5}{6}$ and $a = 15$, what is the value of b?

4. In right △RST, determine the length of side t if $\angle R = 39°$ and $r = 4.3$ m.



☆**5.** Use the tangent ratios and a calculator to determine the measure of each angle, to the nearest tenth of a degree.



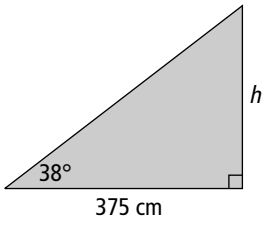
a) $\angle X$

b) $\angle Y$

B Apply

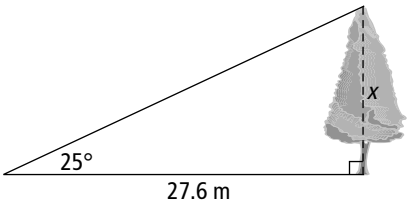
6. Calculate $\angle A$ and $\angle B$ in right △ABC where $\angle C = 90°$, side a measures 3.2 m, and side b measures 2.5 m. What is the measure of side c? Explain how you determined the length of this side.

7. Ms. Singh's design class is required to build model cars. The models are tested for efficiency by releasing them at the top of a ramp and comparing the distances they travel. The ramp extends over a horizontal distance of 375 cm and forms an angle of 38° with the floor. Calculate the height of the ramp to the nearest centimetre.

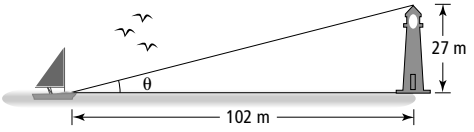


8. Determine the value of each variable. Express your answer to the nearest tenth of a unit.

a)



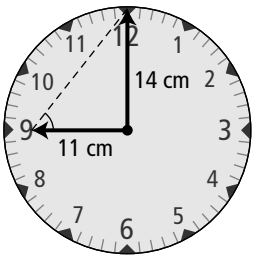
b)



9. The length of a shadow cast by an elm tree is 6.2 m. At the same time, a woman who is 165 cm tall casts a shadow that is 285 cm in length. What is the height of the tree?

10. A wheelchair ramp on a bus forms an angle of 18° with the ground. If the floor of the bus is 65 cm above the ground, how much width does the ramp require beside the bus?

☆**11.** The minute hand of a clock has a length of 14 cm. The length of the hour hand is 11 cm.

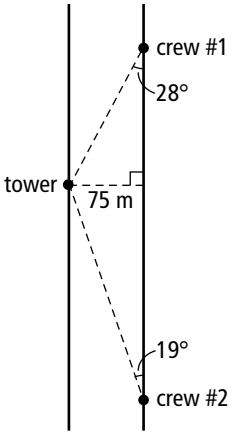


a) If a line is drawn between the ends of the two hands at the 9 o'clock position, what angle is formed between the line and the minute hand?

b) What is the angle between the line in part a) and the hour hand?

C Extend

12. An access road runs 75 m from and parallel to a high voltage power line. Two maintenance crews working along the road at different positions can see the same transmission tower. Looking from the north, crew #1 sees the tower 28° to the west of the road. From the south crew #2 sights the tower 19° to the west of the road. How far apart are the crews?



13. A plane flying at an altitude of 1200 m is directly over a small island. After a few minutes, the island is sighted at an angle 5.2° below and behind the plane. Determine the distance the plane travelled, to the nearest metre.

14. Different types of gravel will form different slopes when piled up. Coarse gravel can sustain an angle of 29° with the horizontal, whereas fine gravel can sustain an angle of 24°. Maria and Nathan are landscapers who need to create a circular mound 1.7 m high. To the nearest tenth of a metre, what is the minimum diameter of mound they can create using

a) coarse gravel?

b) fine gravel?

D Create Connections

15. Jasmine and Ivan are monitoring a pair of falcons nesting on a building ledge that is 112 m above the street. They position their telescope (on a 1.4-m tripod) at street level at a distance of 245 m from the building. At what angle does the telescope need to be set? Calculate your answer to the nearest tenth of a degree.

☆16. Guy wires are lengths of cord or cable used to support towers or poles. For greatest support, four guy wires should be used. They should be spaced evenly around a tower or pole and attached at least two thirds of the way up the structure. They should form an angle with the ground of 60° or less. Ramon wishes to erect a radio tower 6.5 m tall on a piece of property measuring 10 m by 4.2 m.

a) Does Ramon have enough space for proper guy wires?

b) How high a tower, to the nearest tenth of a metre, could Ramon build and support safely in the space?

17. $\triangle ABC$ is a right triangle with the right angle at vertex C.

a) If the triangle has a tangent ratio of 2, state two possible values for each of side a and side b.

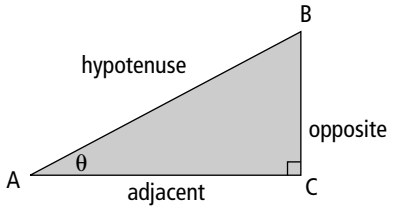
b) If the triangle has a tangent ratio of $\frac{1}{2}$, state two possible values for each of side a and side b.

c) What do you notice about the values in parts a) and b)? Why is this?

3.2 The Sine and Cosine Ratios

KEY IDEAS

- The sine ratio and cosine ratio compare the lengths of the legs of a right triangle to the length of the hypotenuse.



- The sine ratio compares the length of the side opposite an acute angle to the length of the hypotenuse.

$$\sin\theta = \frac{\text{length of side opposite } \theta}{\text{length of hypotenuse}}$$

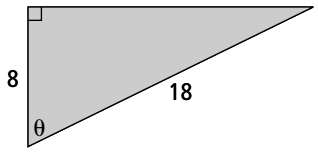
- The cosine ratio compares the length of the side adjacent to an acute angle to the length of the hypotenuse.

$$\cos\theta = \frac{\text{length of side adjacent to } \theta}{\text{length of hypotenuse}}$$

- The sine and cosine ratios can be used to calculate side lengths and angle measures of right triangles.

- Visualizing the information that you are given and that you need to find is important. It helps you determine which trigonometric ratio to use and whether to use the inverse trigonometric ratio.

- Determine the value of θ, to the nearest degree.



$$\cos\theta = \frac{\text{length of side adjacent } \theta}{\text{length of hypotenuse}}$$

$$\cos\theta = \frac{8}{18}$$

$$\theta = \cos^{-1}\left(\frac{8}{18}\right)$$

$\theta = 63.6122...°$

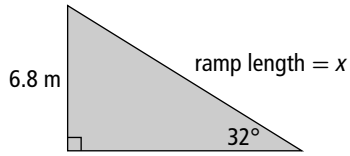
Angle θ is approximately 64°.

Example

Traditionally, ships were constructed in docks on land and then launched by sliding them down a ramp into the water. If the ramp was too steep, there was a risk of capsizing the ship; if it was not steep enough, the ship could get stuck. Engineers determined that a ramp angle of 32° was ideal. At a shipyard, the vertical distance from the construction dock to the water is 6.8 m. Calculate to the nearest tenth of a metre the length of ramp needed to launch a ship safely.

Solution

Organize the information by sketching a diagram to illustrate the problem.



Choose the appropriate trigonometric ratio.
In relation to the 32° angle, the side that measures 6.8 m is the opposite side. The side of unknown length, x, is the hypotenuse. Therefore, use the sine ratio.

$$\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\sin 32° = \frac{6.8 \text{ m}}{x}$$

Isolate the value of x and solve.

$$\sin 32°(x) = 6.8 \text{ m}$$

$$x = \frac{6.8 \text{ m}}{\sin 32°}$$

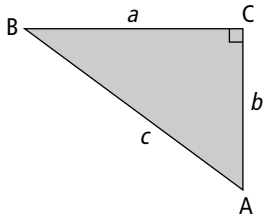
$$x = \frac{6.8 \text{ m}}{0.5299}$$

$$x = 12.83 \text{ m}$$

The length of the ramp must be 12.8 m, to the nearest tenth of a metre.

A Practise

1. Express each trigonometric ratio in relation to right $\triangle ABC$.



a) sin A

b) cos A

c) sin B

d) cos B

2. Using right $\triangle ABC$ in question 1 and the stated values, determine each unknown value.

a) If $b = 12$ cm and $c = 17$ cm, what is the value of cos A?

b) If $a = 10$ cm and $c = 15$ cm, what is the value of sin A?

c) If $b = 1.9$ m and $c = 2.4$ m, what is the value of sin B?

d) If $a = 2.6$ mm and $c = 3.9$ mm, what is the value of cos B?

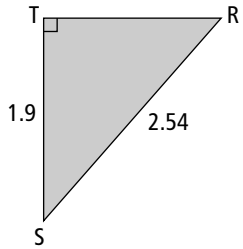
e) If $\sin A = \frac{5}{6}$ and $c = 15$, what is the value of a?

f) If $\cos B = \frac{9}{45}$ and $c = 15$, what is the value of a?

3. Use the sine and cosine ratios and a calculator to determine the measure of each angle, to the nearest tenth of a degree.

a) $\angle R$

b) $\angle S$



4. Use a calculator to determine the measure of each angle, to the nearest tenth of a degree.

a) $\cos A = 0.5835$

b) $\sin B = 0.8358$

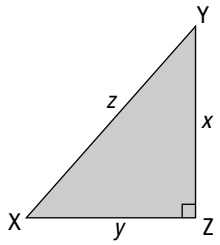
c) $\sin \theta = 0.2181$

d) $\cos \theta = 0.0488$

5. For right $\triangle XYZ$, determine the length of side x to two decimal places if

a) $\angle Y = 38°$ and $z = 2.35$ cm

b) $\angle X = 59°$ and $z = 5.12$ m



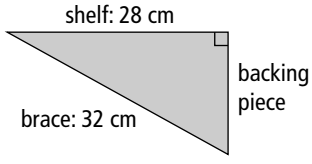
6. For right $\triangle XYZ$ in question 5, calculate the length of side z to two decimal places if

a) $\angle Y = 41°$ and $x = 54.7$ mm

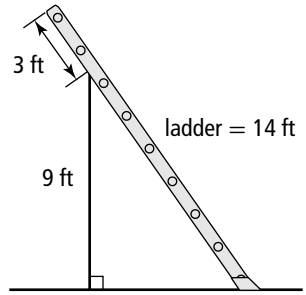
b) $\angle X = 52°$ and $x = 7.64$ m

B Apply

7. Some students in Mr. Pang's wood shop class are building a shelf. The shelf is 28 cm deep and is supported by a 32-cm diagonal brace on each side. Calculate the angle that the brace forms with the backing piece, to the nearest degree. Calculate the required height of the backing piece, to the nearest millimetre.



8. A 14-ft ladder is leaning against a wall 9 ft high in such a way that the top 3 ft of the ladder extend above the top of the wall.

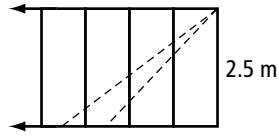


a) What is the horizontal distance from the bottom of the ladder to the wall? Round your answer to the nearest tenth of a foot.

b) What angle does the ladder form with the ground, to the nearest tenth of a degree?

9. A zip line is to be set up from a tree to the ground in the Cortez family's backyard. To prevent people from zipping down too quickly, the line should form an angle of 35° with the ground. To the nearest metre, how long can the zip line be if it is anchored 28 m from the base of the tree?

☆**10.** In areas with extreme winds, houses are constructed with steel rods that run diagonally inside walls to help keep walls square. Rods are sold in standard lengths of 4 m and 5 m.

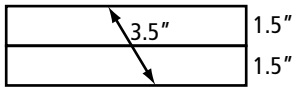


If standard walls are 2.5 m high, what angle does the 5-m rod make with the floor? What angle with the floor does the 4-m rod make? State your answers to the nearest degree.

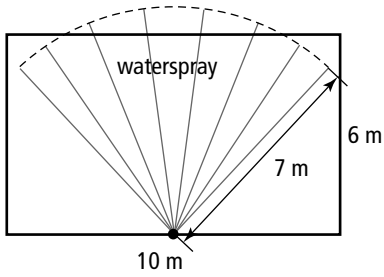
C Extend

11. A boat ramp with a cable winch is to be constructed to allow the McKenzie family to pull their boat from the water for the winter. If the shore has a slope of 39° and the front of the boat must be lifted 3 m above the water, what length does the ramp have to be?

☆12. A 2″ by 4″ length of lumber actually measures 1.5″ by 3.5″. To make a top rail for a deck, a carpenter stacks two pieces of lumber together to create a rail that is 3″ thick. However, the carpenter has only 3.5″ wood screws available. At what angle must he drive the screws in from underneath so that none of the points sticks through the top rail? Round your answer to the nearest degree.



13. A water gun at Splasher's water park is positioned at the centre of the long side of a 10-m by 6-m rectangular pool. The gun can spray to a maximum distance of 7 m.



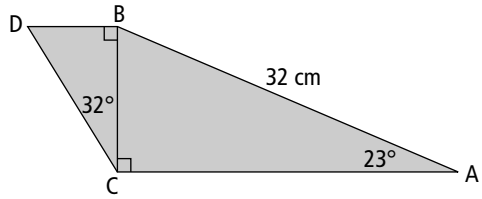
a) How much of the opposite side of the pool can be sprayed?

b) How much of the opposite side cannot be sprayed?

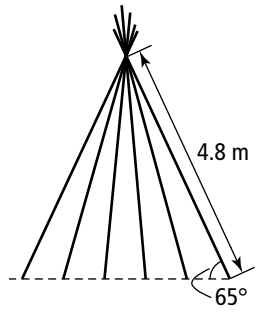
c) What spray distance would the gun need for the spray to reach the entire opposite side? Round each answer to the nearest tenth of a metre.

D Create Connections

14. Determine the length of CD, to the nearest tenth of a centimetre.



☆15. A traditional teepee uses 13 poles to form its conical shape. The poles are inclined at an angle of 65° to the ground and tied together 4.8 m up their length. Calculate the diameter of this structure, to the nearest tenth of a metre.



16. a) Copy the table and determine the trigonometric values for each stated value of θ , to four decimal places.

θ	tan θ	sin θ	cos θ
15°			
30°			
45°			
60°			
75°			

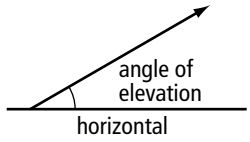
b) Describe any pattern you see in each column.

c) Do you see any relationship between the sine and cosine values? Explain.

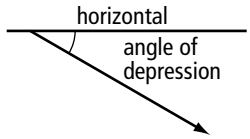
3.3 Solving Right Triangles

KEY IDEAS

- An angle of elevation is the angle between the line of sight and the horizontal when an observer looks upward.



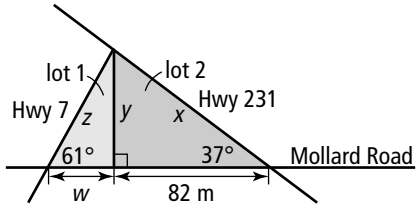
- An angle of depression is the angle between the line of sight and the horizontal when the observer looks downward.



- To solve a triangle means to calculate all unknown angle measures and side lengths.

Example

Two adjoining properties are bordered by three roads, as shown in the diagram. The property owners agree to put a fence around and between both lots. What total length of fencing is required, to the nearest metre? Explain why you should round up or down.



Solution

First, determine the length of fence around the first lot.
Let x represent the length, in metres, of fence required along Hwy 231. Let y represent the length, in metres, of fence required along the property line.
Use the given information and choose the appropriate trigonometric ratio to solve for each value.

For x:

$$\cos 37° = \frac{82 \text{ m}}{x}$$
$$\cos 37°(x) = 82 \text{ m}$$
$$x = \frac{82 \text{ m}}{\cos 37°}$$
$$x = \frac{82 \text{ m}}{0.7986}$$
$$x = 102.68 \text{ m}$$

For y:

$$\tan 37° = \frac{y}{82 \text{ m}}$$
$$(82 \text{ m})(\tan 37°) = y$$
$$(82 \text{ m})\ (0.7536) = y$$
$$y = 61.79 \text{ m}$$

Next, calculate the length of fence needed to complete the fence around the second lot.
Let w represent the length, in metres, of fence required along Mollard Road. Let z represent the length, in metres, of fence required along Hwy 7.
Use the given information and choose the appropriate trigonometric ratio to solve for each value.

For w:

$$\tan 61° = \frac{61.79 \text{ m}}{w}$$
$$w = \frac{61.79 \text{ m}}{\tan 61°}$$
$$w = \frac{61.79 \text{ m}}{1.804}$$
$$w = 34.25 \text{ m}$$

For z:

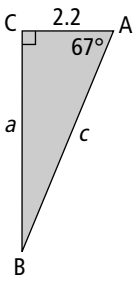
$$\sin 61° = \frac{61.79 \text{ m}}{z}$$
$$z = \frac{61.79 \text{ m}}{\sin 61°}$$
$$z = \frac{61.79 \text{ m}}{0.8746}$$
$$z = 70.65 \text{ m}$$

Total length of fence needed $= 82 \text{ m} + 102.68 \text{ m} + 61.79 \text{ m} + 34.25 \text{ m} + 70.65 \text{ m}$
$= 351.37 \text{ m}$
The two properties require a total of approximately 352 m of fencing. Round up to make sure that there is enough fencing.

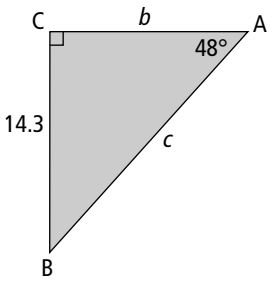
A Practise

1. Solve each triangle. State each answer to the nearest tenth of a unit.

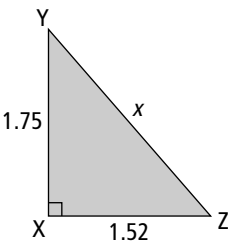
a)



b)

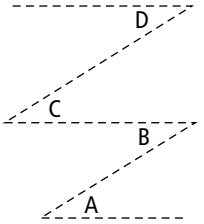


c)



d) Use a second strategy to solve part c).

2. Using the diagram, name



a) two angles of elevation

b) two angles of depression

c) two pairs of equal angles

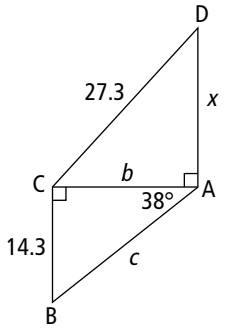
3. Paolo and Chandra are on two balconies facing each other across a courtyard. Chandra sends a text message to Paolo to tell him that she sees him at an angle of depression of 23°. Paolo replies that Chandra is wrong and that Chandra is actually at an angle of elevation of 23°.

a) Who is right? Explain.

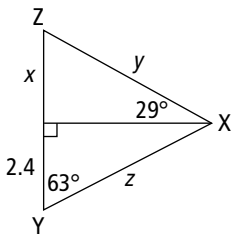
b) What is the relationship between angles of elevation and angles of depression?

4. For each figure, solve all variables. For side lengths, state your answers to the nearest tenth of a unit. For angle measures, give your answers to the nearest degree.

a)

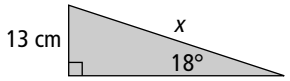


b)

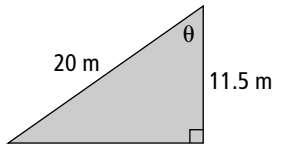


5. Determine the value of each variable. Express your answer to the nearest tenth of a unit.

a)



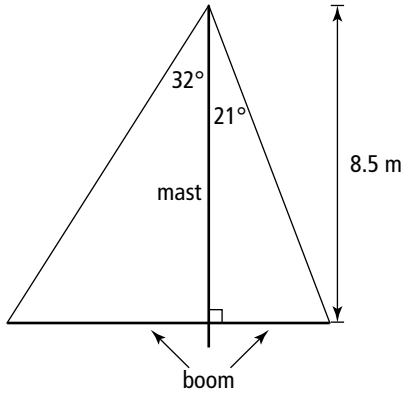
b)



B Apply

☆6. A car is parked on a street 4.8 m from the bottom of Ruthie's apartment building. From her window above the street, Ruthie views the car at an angle of depression of 73°. Kenneth lives directly across the street from Ruthie. From his window at exactly the same height as Ruthie's, Kenneth sees the car at an angle of depression of 59°. Determine the distance between Ruthie's and Kenneth's windows, to the nearest tenth of a metre.

7. There are two sails on the mast of a sailboat. The mast measures 8.5 m from the booms at the bottom of the sails to the top. The main sail meets the mast at an angle of 32° and the secondary sail meets the mast at an angle of 21°. Determine the combined length of the two booms, to the nearest tenth of a metre.



8. Pit mines are cone-shaped excavations often used in diamond mining. The side of one pit mine has an angle of depression of 35° so that it will not collapse.

a) If the mine has a diameter of 576 m, how deep is it?

b) If the mine is required to extend down 250 m, then how wide should it be at the top?

c) If the bottom of the mine is 250 m below the surface, what length does a conveyor belt to the top need to be if it follows the slope of the excavation?

In each case, round your answer to the nearest metre.

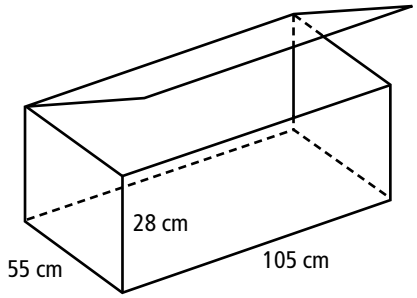
C Extend

9. A footbridge across a river is 12 m above the water. On one side, a ramp slopes to the bridge at an angle of 7°. On the other side, there is a set of stairs. The bottom of the stairs is 10 m from the bridge.

a) What is the distance from the bottom end of the ramp to the bridge?

b) At what angle do the stairs climb to the bridge?

10. A box measures 55 cm deep, 28 cm high, and 105 cm long.

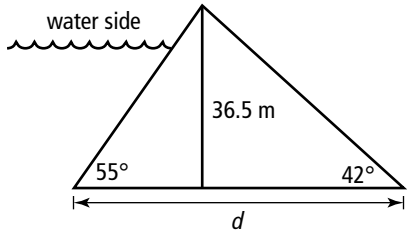


José wishes to use this box to hold his great-grandfather's cane, a family heirloom. The cane has a length of 120 cm.

a) Can the cane fit flat in the box?

b) Can José put the cane completely in the box without interfering with the lid? Explain.

☆**11.** A section of dike is to be constructed to hold water in a reservoir for a hydro-electric power dam. The dike needs to be built to a height of 36.5 m, with a slope of 55° on the reservoir side and a slope of 42° on the outside.



a) How wide is the dike at its base?

b) A wire mesh is to be attached to the outside slope of the dike to prevent rock slides.

Determine the length required for the wire mesh.

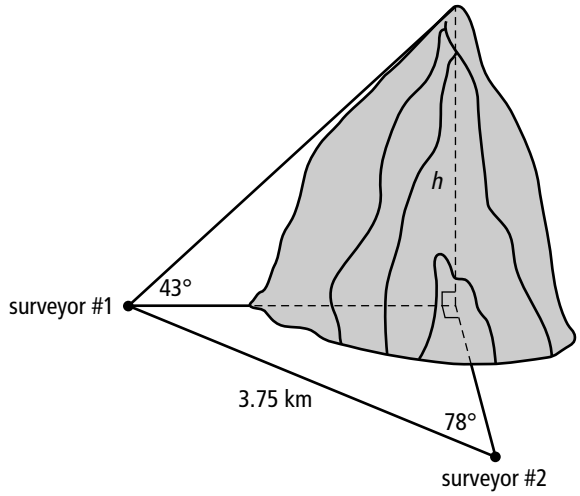
c) A different section of dike requires a height of 39 m. What is the width of its base?

d) A student engineer believes that for a 31-m-high section, the base needs to be 54.8 m wide. Is she correct? Explain.

Express each answer to the nearest tenth of a metre.

D Create Connections

☆**12.** In order to accurately measure the height of a mountain that cannot be climbed, two right triangles can be used. One lies horizontally along the ground and the other stands vertically with a vertex at the mountain's peak.



Two surveyors are 3.75 km apart. Surveyor #1 is directly west of the peak and surveyor #2 is directly south. From the position of the second surveyor, the first is at an angle of 78° west of north. Surveyor #1 can see the peak at an angle of elevation of 43°.

a) Determine the height of the mountain, to the nearest metre.

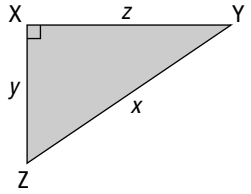
b) How long would a cable need to be, to the nearest metre, in order to connect the peak with the position of surveyor #1?

c) Solve this problem using a second set of strategies.

Chapter 3 Review

3.1 The Tangent Ratio

1. For $\angle Y$ in right $\triangle XYZ$, identify



a) the hypotenuse

b) the adjacent side

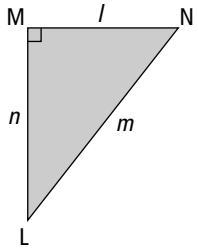
c) the opposite side

2. Refer to right $\triangle XYZ$ in question 1.

a) State the tangent ratio of $\angle Y$.

b) State the tangent ratio of $\angle Z$.

3. For right $\triangle LMN$, determine the length n if $\angle N = 68°$ and $l = 12.4$ cm.



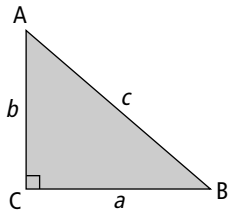
4. Calculate the smallest angle in right $\triangle ABC$ where $\angle C = 90°$, side a measures 32.7 m, and side b measures 27.2 m.

5. A ramp on a moving truck forms an angle of 30° with the ground, allowing movers to load heavy items easily. If the truck bed is 1.35 m above the ground, how far will the ramp extend behind the truck?

6. The length of a shadow cast by a building is 25 m. Nearby, a 1.8-m shadow is cast by a man who is 2.2 m tall. Calculate the height of the building.

3.2 The Sine and Cosine Ratios

7. For right $\triangle ABC$, state each of the following ratios.



a) sin A

b) cos A

c) sin B

d) cos B

8. Calculate the value of b in $\triangle ABC$ in question 7 if

a) $\angle B = 23°$ and $c = 12$

b) $\angle A = 67°$ and $c = 9.2$

9. A ladder 7 m in length is leaning against a wall. The top of the ladder forms an angle of 20° with the wall. Determine the distance from the bottom of the wall to the bottom of the ladder.

10. Inflatable slides are used to evacuate people from airplanes. If a slide must form an angle of 35° with the ground and its bottom will be 4.5 m from the plane, what length does the slide need to be?

11. The length of a ramp from the ground level of a parking garage to the upper level is 54 ft.

a) If the height of the upper level is 8 ft, what angle does the ramp make with the ground?

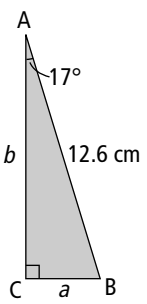
b) Over what horizontal distance does the ramp extend?

Round your answers to the nearest tenth of a unit.

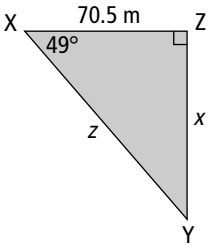
3.3 Solving Right Triangles

12. Solve each triangle, to the nearest tenth of a unit.

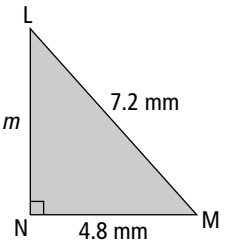
a)



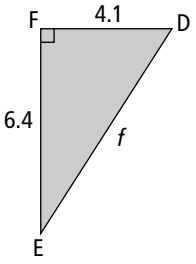
b)



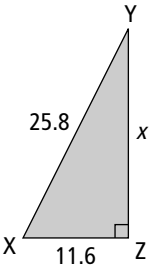
c)



d)

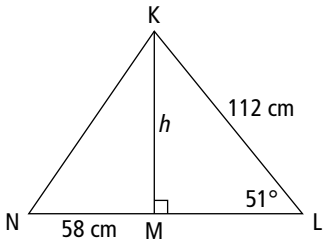


e)



f) Use a second strategy to solve part c).

13. Consider adjacent right triangles KLM and KMN shown in the figure.



a) What is the height of side *h*, to the nearest centimetre?

b) What is the measure of ∠MKN, to the nearest degree?

14. A surveyor is trying to determine the height of a cliff. From her location, 1375 m from the base of the cliff, the angle of elevation to the top of the cliff is 27°. What is the height of the cliff, to the nearest metre?

15. A hot-air balloon is floating 105 metres above a soccer field 100 m long. A photographer in the balloon's basket can see the two goalkeepers standing on their goal lines. One is at an angle of depression of 53.39°. The other is at an angle of depression of 78.17°. If the balloon is directly between the goalies, how far, to the nearest metre, is each goalie from a point on the ground directly under the balloon?

16. The top of a skyscraper is 200 m above the ground. You are standing 100 m from the base of the building. Your friend is 20 m behind you. Each of you has a clear view of the top of the building.

a) What is the distance between the top of the building and your friend?

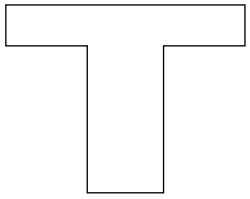
b) What is the distance between the top of the skyscraper and you?

c) From your position, at what angle of elevation does the top of the building appear to be?

Round your answers to the nearest tenth of a unit.

Chapters 1–3 Cumulative Review

1. **a)** Estimate the perimeter of the figure in an appropriate SI unit.



b) Measure the perimeter of the figure.

c) Calculate the area of the figure, to the nearest hundredth of a unit.

2. Sketch a diagram to illustrate a right pyramid with a square base measuring 14 ft by 14 ft and a slant height of 9 ft. What is the surface area of the pyramid?

3. Draw right $\triangle FGH$ in which $\angle G$ is the right angle.

a) Label the leg opposite $\angle H$, the leg adjacent to $\angle H$, and the hypotenuse.

b) State the tangent, sine, and cosine ratios of $\angle H$.

4. Calculate the missing dimension in each of the following. Round each answer to the nearest hundredth of a unit.

a) A right cone has a surface area of 15 m^2 and a radius of 1.7 m.

b) The square base of a right pyramid has an area of 1521 cm^2. The pyramid has a total surface area of 4407 cm^2.

c) A sphere has a surface area of 475 mm^2.

5. Calculate the measure of each angle, to the nearest degree.

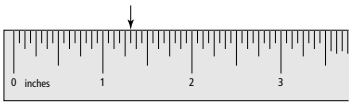
a) $\cos A = 0.2345$

b) $\sin C = 0.8860$

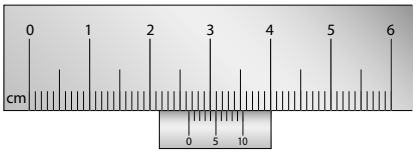
c) $\tan \theta = \frac{4}{3}$

6. What is the reading on each measuring device? Estimate and then calculate each equivalent measurement in the other system (SI or imperial), to the nearest hundredth of a unit.

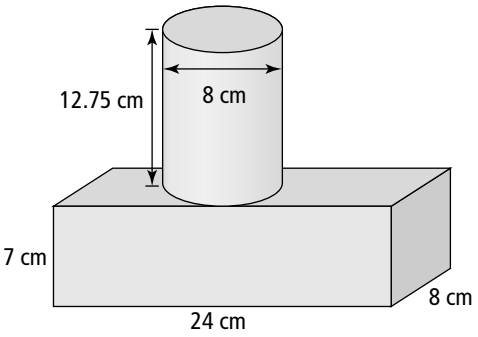
a)



b)



7. Calculate the surface area of this object composed of a rectangular prism and a cylinder.



8. Calculate the volume of each of the following. Where necessary, express your answers to the nearest hundredth of a unit.

a) A cylinder has a radius of 16 ft and a height of 12 ft.

b) A cone has a height of 19 cm and a diameter of 7.5 cm.

c) A rectangular pyramid has a base measuring 6 ft by 8 ft and a height of 12 ft.

d) A sphere has a radius of 6.2 cm.

e) A cylinder has a height of 6 in. and a radius of 3 in.

f) A rectangular prism has a height of 3 m, a width of 4 m, and a length of 5 m.

9. Calculate the missing dimension in each of the following, to the nearest hundredth of a unit.

a) A cylinder has a volume of 3 m^3 and a height of 1.2 m.

b) A cone has a radius of 35 cm and a volume of 9500 cm^3.

c) A square-based pyramid has a height of 85 cm and a volume of 4.6 m^3.

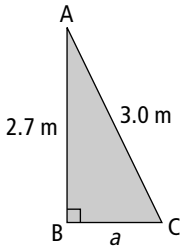
d) A sphere has a volume of 3467 cm^3.

e) A cylinder has a volume of 6 $in.^3$ and a height of 5 in.

f) A rectangular prism has a volume of 252 ft^3, with a length of 12 ft, and a width of 7 ft.

10. Solve each triangle to the nearest tenth of a unit.

a)



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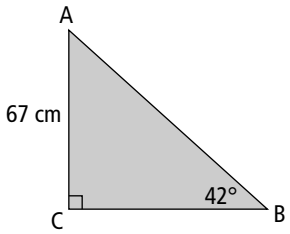


11. Two forest fires are spotted on opposite sides of an observation tower. From the top of the tower, the angle of depression to one fire is 3°. The angle of depression to the other fire is 7°.

a) If the observation tower is 75 m high, how far apart are the fires?

b) Suppose the two fires were on the same side of the tower on the same compass heading. How far apart would they be then?

12. A standard shipping container is in the form of a rectangular prism with a length of 12.01 m, a width of 2.33 m, and a height of 2.38 m. Suppose a fully loaded ship arriving in the Port of Vancouver is carrying 5000 such containers.

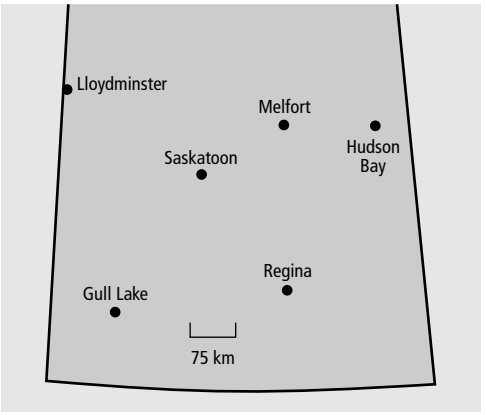
a) What is the storage capacity of each container? of the ship?

b) If the trailer of a transport truck measures 2.74 m by 2.54 m by 16.15 m, how many truckloads of cargo can one container hold? How many truckloads would it take to fill all the containers on the ship?

c) What is the total surface area of the 5000 containers?

Where appropriate, round your answers to the nearest hundredth of a unit.

13.



a) Express the scale of the map as a ratio in lowest terms.

b) How many kilometres are represented by one inch?

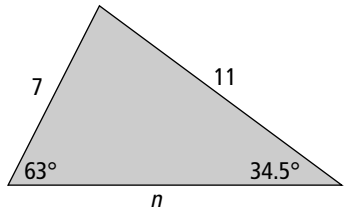
c) Estimate the distance from Gull Lake to Regina. Give your answer in miles.

d) The distance from Saskatoon to Melfort is shorter than the distance from Saskatoon to Lloydminster. How many miles shorter is it?

Chapter 3 Extend It Further

For 1 to 3, choose the best answer.

1. What is the length of the base n?



A 12.3 **B** 16.1

C 17.2 **D** 19.2

☆**2.** A child swings back and forth, reaching a maximum angle of 32° with the vertical. The swing is 3.4 m long and 0.75 m from the ground when at rest. What maximum height above the ground does the child reach?

A 2.64 m **B** 2.18 m

C 1.27 m **D** 0.98 m

3. Dad used to walk uphill to school every day. He travelled a distance of 2 km at a slope of 12°, then another 3 km horizontally. Finally, he walked a further distance of 1.5 km at a slope of 15° before reaching school. How far vertically was the school from the starting point?

A 0.7 km **B** 0.8 km

C 0.9 km **D** 1.0 km

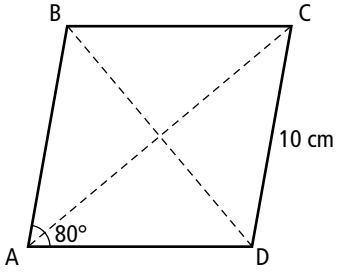
4. Romeo has a ladder 4 m long. He leans the ladder against a vertical wall, making an angle of 26°. As Romeo reaches Juliet's window, the ladder slips, then stops when it is making an angle of 34° with the wall.

a) How far vertically has the ladder slipped?

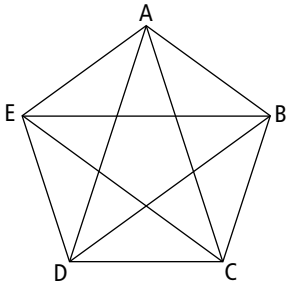
b) How far horizontally has the ladder slipped?

c) Compare the two distances. What do you notice? Explain.

5. ABCD is a rhombus of side 10 cm and $\angle A = 80°$. Determine lengths AC and BD, to one decimal place. Hint: AC $\perp$ BD.



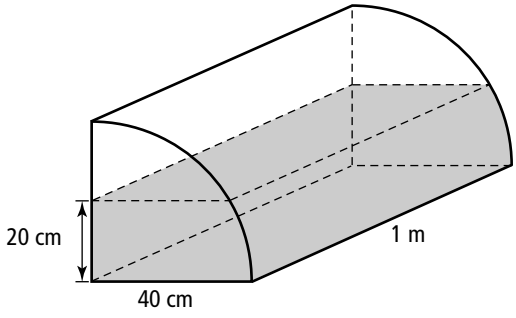
6. ABCDE is a pentagon. Each side is 10 cm long. Determine



a) the measure of $\angle EDC$

b) the total length of a pentagonal star connecting A to D to B to E to C, and back to A

7. A fuel tank has a length of 1 m and a cross-section that is a quarter of a circle having a radius of 40 cm. The tank is filled with gasoline to a height of 20 cm. What is the volume of the fuel?



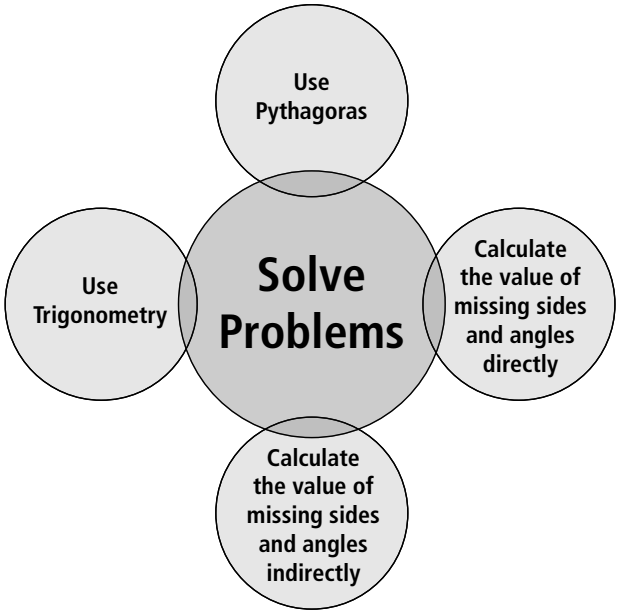
Chapter 3 Study Check

Use the chart below to help you assess the skills and processes you have developed during Chapter 3. The references in italics direct you to pages in *Mathematics 10 Exercise and Homework Book* where you could review the skill. How can you show that you have gained each skill? What can you do to improve?

Big Idea	Skills	This Shows I Know	This Is How I Can Improve
Use Pythagoras and trigonometry to solve problems *pages 39–55*	✓ Apply the Pythagorean theorem to calculate the length(s) of missing side(s) *pages 48–50, 52, 54*		
	✓ Use trigonometric ratios to calculate the value(s) for missing side(s) and angle(s) *pages 39–55*		
	✓ Solve direct measurement problems using Pythagoras and/or trigonometry *pages 39–55*		
	✓ Solve indirect measurement problems using Pythagoras and/or trigonometry *pages 42, 46, 49–50, 52, 54–55*		
Solve right triangles *pages xx*	✓ Apply the Pythagorean theorem to solve for the length(s) of missing side(s) *pages 48–50, 52, 54–55*		
	✓ Use trigonometric ratios to solve for the length(s) of missing side(s) of right triangles *pages 39–55*		
	✓ Use trigonometric ratios to solve for the value(s) of missing angle(s) of right triangles *pages 44–46, 48–55*		

Organizing the Ideas

How can you use this Venn diagram to help you decide which procedure to use in various circumstances? Show how the information provided in a particular problem affects the procedure used to solve it. Show an example of the procedure itself, then identify the information from the problem that must be present to use that procedure.



Study Guide

Review the types of problems you handled in Chapter 3. What do you need to remember to help you do similar problems?

Things to Remember About Triangle Problems

Use Pythagoras

Use Trigonometry

Use Pythagoras and Trigonometry Together