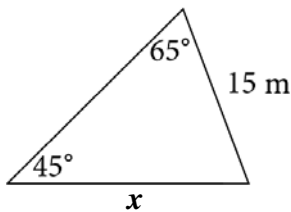


**Worksheet 1-8: Problem Solving with Trigonometry**

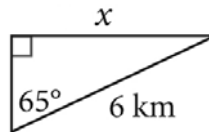
- Step 1:** Read the question carefully. Pay attention to special terminology.
- Step 2:** Draw a triangle to illustrate the situation. Decide on whether the triangle is a right triangle or a non-right triangle.
- Step 3:** Label the triangle with all the given information and mark the unknown side or angle to be solved.
- Step 4:** Write a let statement for the unknown side or angle to be solved.
- Step 5:** If the triangle is a right triangle, decide on which trigonometric ratio (SOH CAH TOA) is to be used. (*Hint: Label the sides in relation to the angle of interest.*)
- Step 6:** If the triangle is a non-right triangle, decide on whether sine law or cosine law is to be used. (*Hint: If two sides and one opposite angle are given or two angles and one side are given → use **sine** law. If three sides are given or two sides and the contained angle are given → use **cosine** law.*)
- Step 7:** Use the appropriate formula to solve for the unknown side or angle. Write an answer statement for the question. (*You are finally done!*)

1. Examine each triangle and decide the appropriate formula to be used to solve for  $x$ .

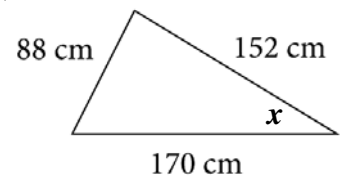
(a)



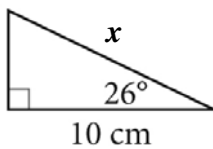
(b)



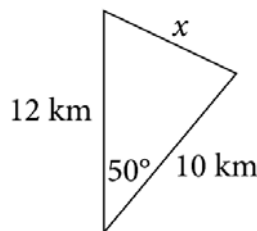
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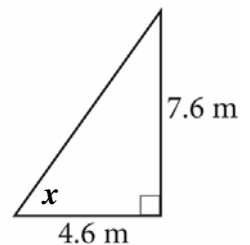
(d)



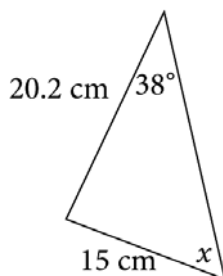
(e)



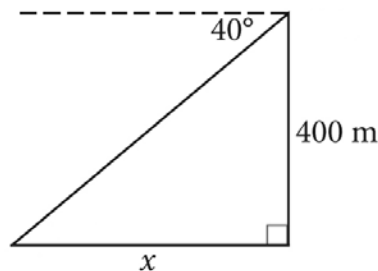
(f)



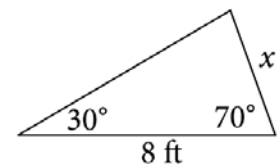
(g)



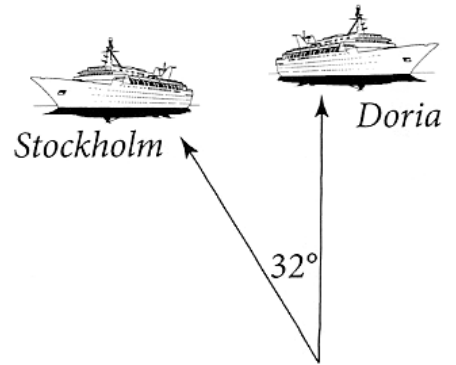
(h)



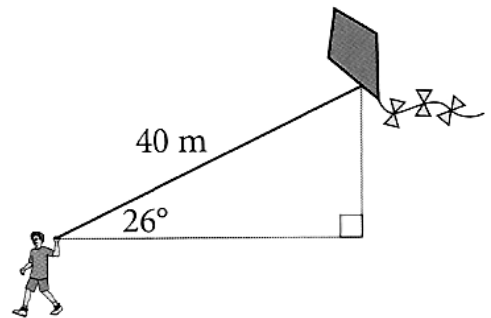
(i)



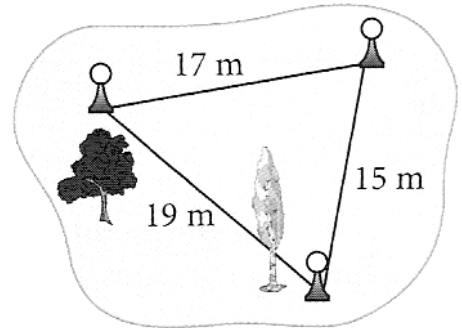
2. Two ships leave port at exactly the same time. Doria heads north at 19 km/h, and Stockholm heads  $32^\circ$  west of north at 22 km/h. Calculate how far apart the two ships are after two hours, to the nearest kilometre.



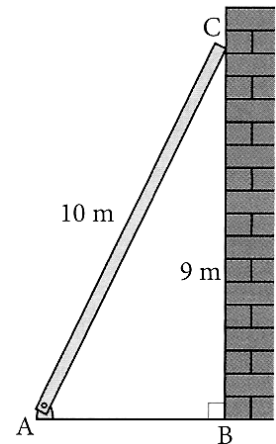
3. Chi is flying his kite. The kite string is 40 m long. The angle of elevation the string makes with the horizontal is  $26^\circ$ , and Chi is holding the end of the string at 1.5 m above the ground. What is the height of the kite above the ground, to the nearest metre?



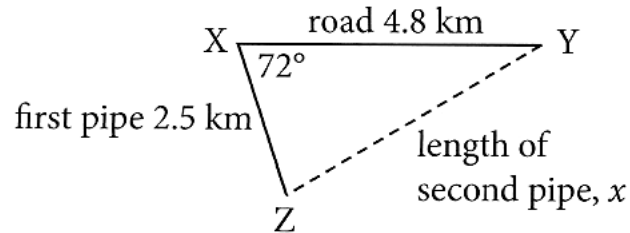
4. Three lights are located in a park along three different paths. The distance between the first light and the second light is 15 m. The distance between the second light and the third light is 19 m. The distance between the first light and the third light is 17 m. Calculate the angles between the lights, to the nearest tenth of a degree.



5. A 10-m ladder leans against a wall. The top of the ladder is 9 m above the ground. Safety standards call for the angle between the base of the ladder and the ground to be between  $70^\circ$  and  $80^\circ$ . Is the ladder safe to climb according to the safety standards?



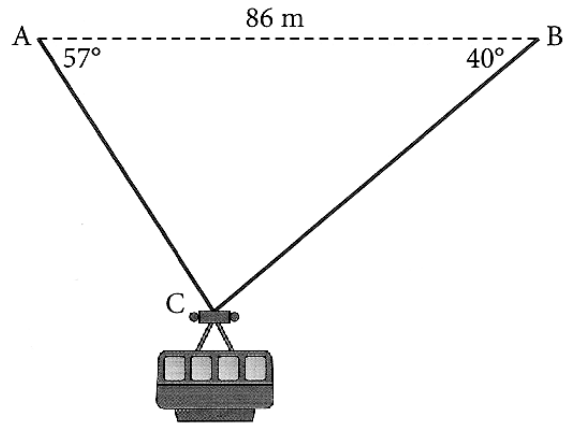
6. A sewer pipe for a new subdivision has to be laid underground. A connection is made to the main service pipe at either end of the 4.8-km stretch of road. One pipe, 2.5 km long, makes an angle of  $72^\circ$  at one end of the road.



- (a) Calculate the length of the second pipe that will connect the first pipe to the other end of the road, to the nearest tenth of a kilometre.

- (b) What is the measure of the angle made by connecting the two pipes, to the nearest degree?

7. A cable car stops part of the way across an 86-m wide gorge. The cable holding the car makes an angle of depression of  $57^\circ$  to the car at one end and an angle of depression of  $40^\circ$  to the car at the other end. How long is the cable that holds the car, to the nearest metre?



8. Two tracking stations, 5 km apart, track a weather balloon floating between them. The tracking station to the west tracks the balloon at an angle of elevation of  $52^\circ$ , and the station to the east tracks the balloon at an angle of elevation of  $60^\circ$ . How far is the balloon from the closest tracking station, to the nearest tenth of a kilometre?

9. Three cell phone towers form a triangle. The distance between the first tower and the second tower is 16 km. The distance between the second tower and the third tower is 19 km. The distance between the first tower and the third tower is 19 km. Calculate the angles between the cell phone towers, to the nearest tenth of a degree.

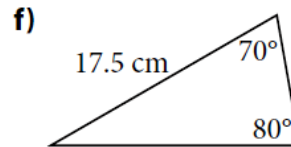
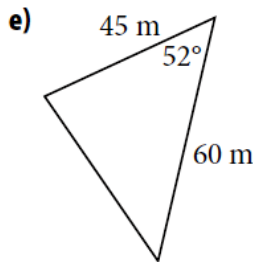
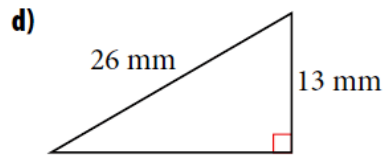
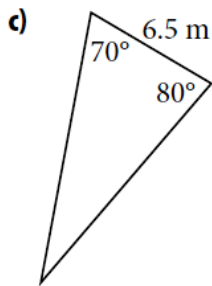
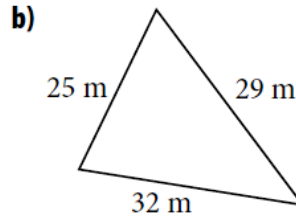
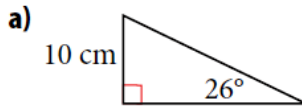
10. A tree is splintered by lightning 2 m up its trunk, so that the top part of the tree touches the ground. The angle the top of the tree forms with the ground is  $70^\circ$ . Before it was splintered, how tall was the tree, to the nearest tenth of a metre?

**Answers:** 1. (a) sine law, (b) sine ratio, (c) cosine law, (d) cosine ratio, (e) cosine law, (f) tangent ratio, (g) sine law, (h) tangent ratio, (i) sine law; 2. 23 km; 3. 19 m; 4. angle from the 1<sup>st</sup> light =  $72.5^\circ$ , angle from the 2<sup>nd</sup> light =  $58.6^\circ$ , angle from the 3<sup>rd</sup> light =  $48.9^\circ$ ; 5. No, angle =  $64^\circ$ , less than  $70^\circ$ ; 6. (a) 4.7 km, (b)  $76^\circ$  (sine) or  $77^\circ$  (cosine); 7. 129 m (56 m + 73 m); 8. 4.2 km; 9. angle from 1<sup>st</sup> tower =  $65.1^\circ$ , angle from 2<sup>nd</sup> tower =  $65.1^\circ$ , angle from 3<sup>rd</sup> tower =  $49.8^\circ$ ; 10. 4.1 m (2 m + 2.1 m).

**Practise**

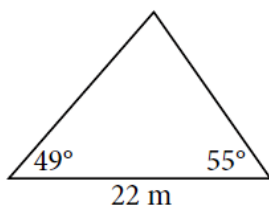
Round your answers to the nearest tenth, where necessary.

1. Work in pairs. One partner chooses a triangle. The other partner decides which formula to use to solve it.



2. Refer to question 1. Solve each triangle.

8. A triangular garden is to be enclosed by a fence. How much fencing will be required?

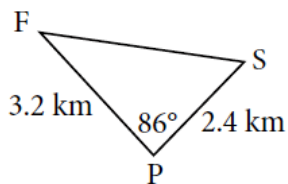


9. Complete the information needed to solve each triangle. Draw the triangle to help you explain.

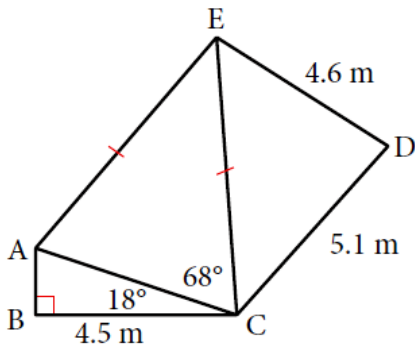
- a) a right triangle, given one side and ■
- b) an acute triangle, given two sides and ■
- c) an acute triangle, given one angle and ■

11. The three stages of a triathlon involve swimming, cycling, and running, in that order. The distances for each stage can vary. For a triathlon held in Hawaii each year, competitors swim across an ocean bay, cycle 180.2 km, and run 42.2 km. In the diagram, S is the start of the swim and F is the finish of the swim. A surveyor, at point P, used the dimensions shown to calculate the length of SF across the ocean bay.

- a) Find the distance the athletes swim in the Hawaiian triathlon.  
b) What is the total distance of the race?  
c) What assumptions have you made?



13. Find the measure of  $\angle CED$  to the nearest degree.



## Answers

1. a) primary trigonometric ratios  
b) cosine law  
c) sine law  
d) primary trigonometric ratios  
e) cosine law  
f) sine law
2. a)  $64^\circ$ , 20.5 cm, 22.8 cm      b)  $48.1^\circ$ ,  $59.7^\circ$ ,  $72.3^\circ$   
c)  $30^\circ$ , 12.2 m, 12.8 m      d)  $30^\circ$ ,  $60^\circ$ , 22.5 mm  
e)  $47.7^\circ$ ,  $80.3^\circ$ , 48.0 m      f)  $30^\circ$ , 8.9 cm, 16.7 cm
8. 57.7 m
9. a) one angle      b) one angle      c) two sides
10. a) 4.4 km      b)  $65.8^\circ$ ,  $52.2^\circ$
12. No; the shot will go 0.5 m wide of the net.
13.  $53^\circ$