1. Morana is trolling for salmon in Lake Ontario. She sets the fishing rod so that its tip is 1 m above water and the line forms an angle of 35° with the wat er's surface. She knows that there are fish at a depth of 45 m. Describe the steps you would use to calculate the length of line she must let out.
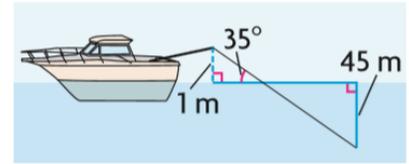
2. Josh is building a garden shed that is 4.0 m wide. The two sides of the roof are equal in length and must meet at an angle of 80°. There will be a 0.5 m overhang on each side of the shed. Josh wants to determine the length of each side of the roof.
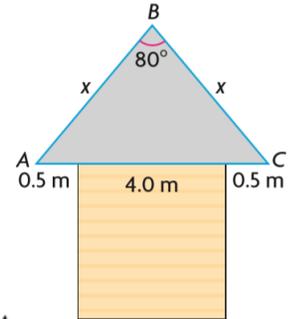
   a) Should he use the sine law or the cosine law? Explain.

   b) How could Josh use the primary trigonometric ratios to calculate x? Explain.

3. Determine the value of x to the nearest centimetre and θ to the nearest degree. Explain your reasoning for each step of your solution.

   a)

   b)

   c)

   d)
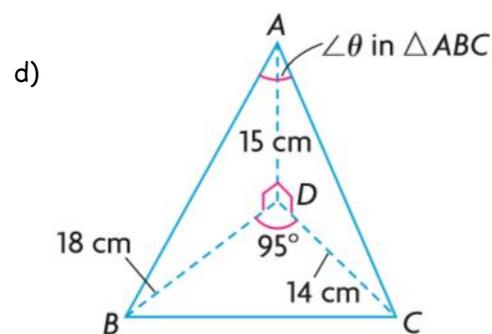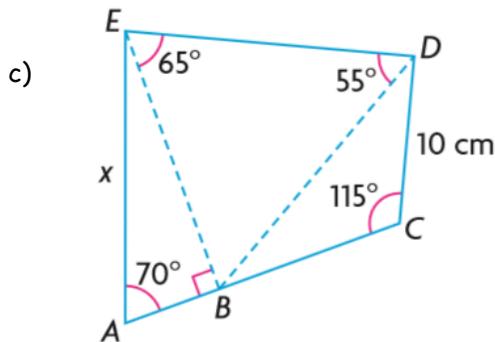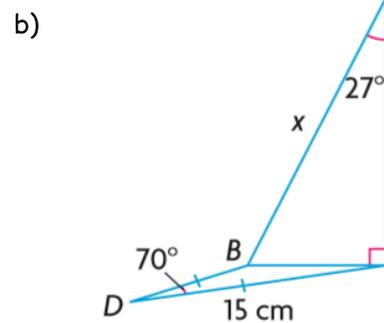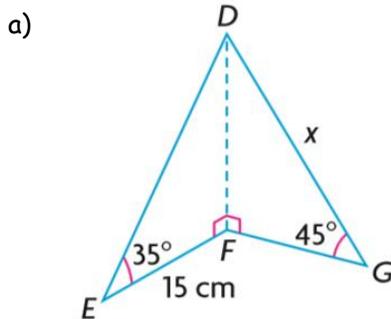
4. As a project, a group of students was asked to determine the altitude, h, of a promotional blimp. The students' measurements are shown in the sketch at the left.

   a) Determine h to the nearest tenth of a metre. Explain each of your steps.

   b) Is there another way to solve this problem? Explain.
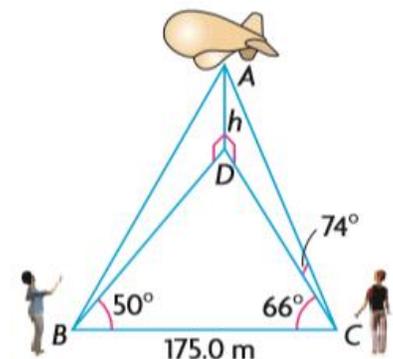
5. While Travis and Bob were flying a hot-air balloon from Beamsville to Vineland in southwestern Ontario, they decided to calculate the straight-line distance, to the nearest metre, between the two towns.

   - From an altitude of 226 m, they simultaneously measured the angle of depression to Beamsville as 2° and to Vineland as 3°

   - They measured the angle between the lines of sight to the two towns as 80°

   Is there enough information to calculate the distance between the two towns? Justify your reasoning with calculations.

6. The observation deck of the Skylon Tower in Niagara Falls, Ontario, is 166 m above the Niagara River. A tourist in the observation deck notices two boats on the water. From the tourist's position,

   - the bearing of boat A is 180° at an angle of depression of 40°

   - the bearing of boat B is 250° at an angle of depression of 34°

   Calculate the distance between the two boats to the nearest metre.

7. Suppose Romeo is serenading Juliet while she is on her balcony. Romeo is facing north and sees the balcony at an angle of elevation of 20°. Paris, Juliet's other suitor, is observing the situation and is facing west. Paris sees the balcony at an angle of elevation of 18°. Romeo and Paris are 100 m apart as shown. Determine the height of Juliet's balcony above the ground, to the nearest metre.
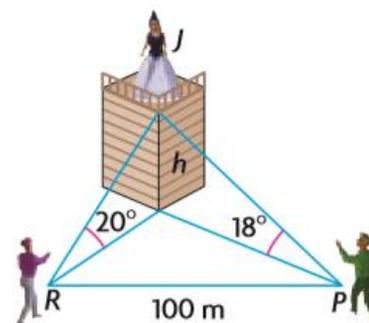

8. A coast guard helicopter hovers between an island and a damaged sailboat.

   - From the island, the angle of elevation to the helicopter is 73°

   - From the helicopter, the island and the sailboat are 40° apart.

   - A police rescue boat heading toward the sailboat is 800 m away from the scene of the accident. From this position, the angle between the island and the sailboat is 35°.

   - At the same moment, an observer on the island notices that the sailboat and police rescue boat are 68° apart.

   Explain how you would calculate the straight-line distance, to the nearest metre, from the helicopter to the sailboat. Justify your reasoning with calculations.

9. Brit and Tara are standing 13.5 m apart on a dock when they observe a sailboat moving parallel to the dock. When the boat is equidistant between both girls, the angle of elevation to the top of its 8.0 m mast is 51° for both observers. Describe how you would calculate the angle, to the nearest degree, between Tara and the boat as viewed from Brit's position. Justify your reasoning with calculations.

10. In setting up for an outdoor concert, a stage platform has been dismantled into three triangular pieces as shown.
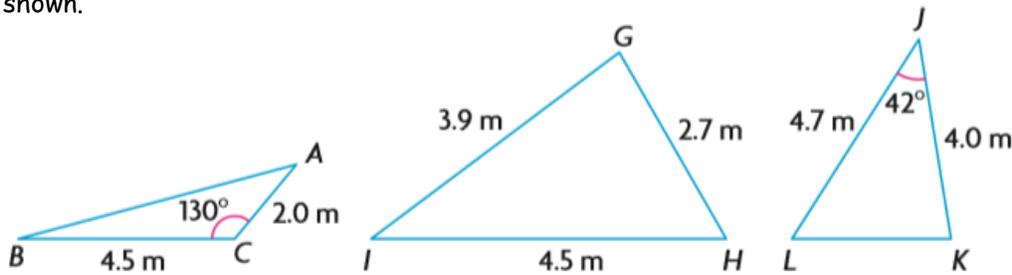
There are three vehicles available to transport the pieces. In order to prevent damaging the platform, each piece must fit exactly inside the vehicle. Explain how you would match each piece of the platform to the best-suited vehicle. Justify your reasoning with calculations.
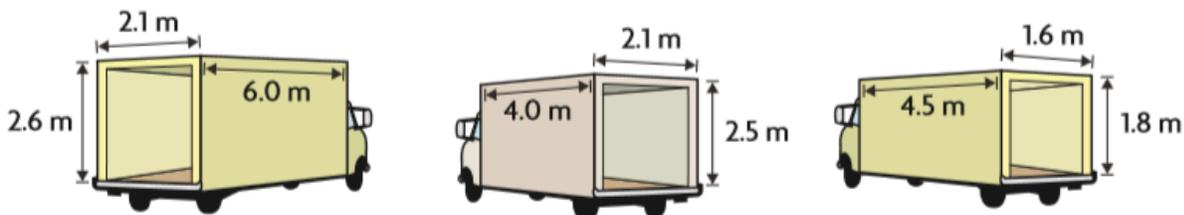
11. Bert wants to calculate the height of a tree on the opposite bank of a river. To do this, he lays out a baseline 80 m long and measures the angles as shown at the left. The angle of elevation from A to the top of the tree is 28°. Explain if this information helps Bert to calculate the height of the tree to the nearest metre. Justify your reasoning with calculations.
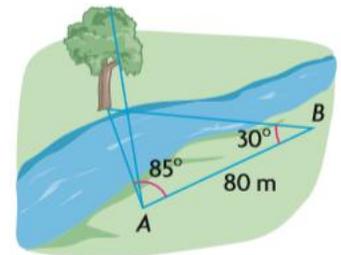
12. Chandra's homework question reads like this:
    Bill and Chris live at different intersections on the same street, which runs north to south. When both of them stand at their front doors, they see a hot-air balloon toward the east at angles of elevation of 41° and 55°, respectively. Calculate the distance between the two friends.

    a) Chandra says she doesn't have enough information to answer the question. Evaluate Chandra's statement. Justify your reasoning with calculations.

    b) What additional information, if any, would you need to solve the problem? Justify your answer.

13. Two roads intersect at 34°. Two cars leave the intersection on different roads at speeds of 80 km/h and 100 km/h. After 2 h, a traffic helicopter that is above and between the two cars takes readings on them. The angle of depression to the slower car is 20°, and the straight-line distance from the helicopter to that car is 100 km. Assume that both cars are travelling at constant speed.

    a) Calculate the straight-line distance, to the nearest kilometre, from the helicopter to the faster car. Explain your reasoning for each step of your solution.

    b) Determine the altitude of the helicopter to the nearest kilometre.

14. Simone is facing north at the entrance of a tunnel through a mountain. She notices that a 1515 m high mountain in the distance has a bearing of 270° and its peak appears at an angle of elevation of 35°. After she exits the tunnel, the same mountain has a bearing of 258° and its peak appears at an angle of elevation of 31°. Assuming that the tunnel is perfectly level and straight, how long is it to the nearest metre?

15. An airport radar operator locates two planes flying toward the airport. The first plane, P, is 120 km from the airport, A, at a bearing of 70° and with an altitude of 2.7 km. The other plane, Q, is 180 km away on a bearing of 125° and with an altitude of 1.8 km. Calculate the distance between the two planes to the nearest tenth of a kilometre.

16. Mario is standing at ground level exactly at the corner where two exterior walls of his apartment building meet. From Mario's position, his apartment window on the north side of the building appears 44.5 m away at an angle of elevation of 55°. Mario notices that his friend Thomas's window on the west side of the building appears 71.0 m away at an angle of elevation of 34°.

    a) If a rope were pulled taut from one window to the other, around the outside of the building, how long, to the nearest tenth of a metre, would the rope need to be? Explain your reasoning.

    b) What is the straight-line distance through the building between the two windows? Round your answer to the nearest tenth of a metre.

Answers

1. Answers may vary. For example, use primary trigonometric ratios to calculate the hypotenuse of each right triangle. Add the results together to get the length of line needed.

2. a) Answers may vary. For example, if you use the sine law, you don't have to solve a quadratic equation.

    b) Answers may vary. For example, use a right triangle with acute angles 40° and 50°. Then, solve $\cos 50° = 2.5/x$.

3. a) 15 cm   b) 37.9 cm   c) 17 cm   d) 93°

4. a) 520.5 m   b) Use the sine law, then trigonometric ratios.

5. Yes, the distance is about 7127 m.

6. 258 m

7. 24 m

8. 736 m

9. 47°

10. 4.5 m, 2.0 m, 6.0 m piece fits in 2.6 m 2.1 m 6.0 m vehicle. Other two pieces fit in 2.5 m 2.1 m 4.0 m vehicle.

11. Yes, the height is about 23 m.

12. a) You can't solve the problem.

    b) You need the altitude of the balloon and angle of depression from the balloon to Bill and Chris.

13. a) 39 km   b) 34 km

14. 524 m

15. 148.4 km

16. a) 84.4 m   b) 64.2 m